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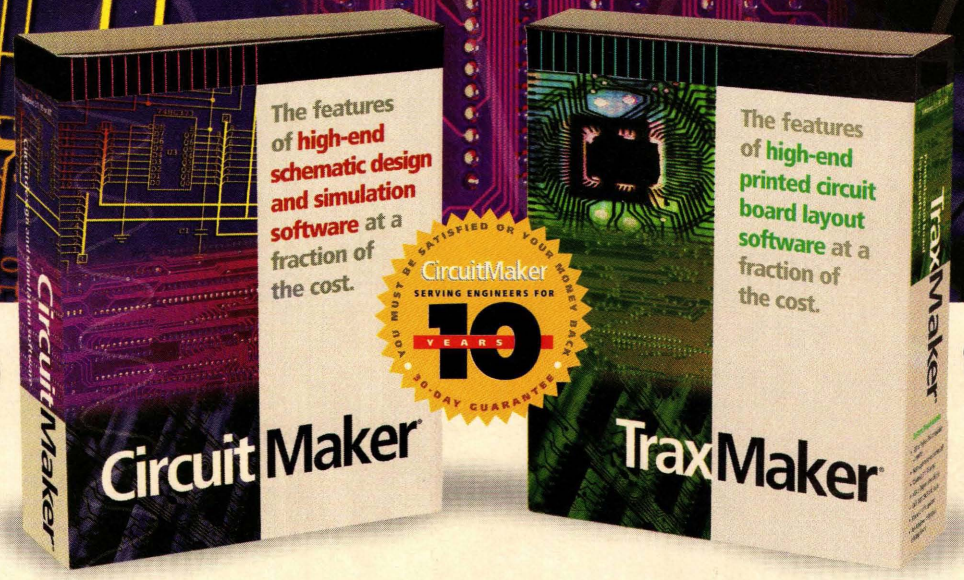
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CIRCLE 133 ON FREE INFORMATION CARD

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The millennium is upon us. The year 2000 is right around the corner. What will it bring? — ***Poptronics*** *– the magazine for the hands-on electronics activist!*

Today's challenging electronics marketplace does not leave room for a variety of competitive publications aimed at the hands-on kind of electronics activist — the professionals who design, build, maintain, and repair all of the electronics gear that fills our lives, the experimenters who build projects, the computer enthusiasts who want to know what's in the latest gear, the activists who want to and are building robots, audiophiles who want to test new circuits and designs, ham-radio operators looking for what's out there to communicate with.

That's why Gernsback Publications is melding our two publications – *Electronics Now* and *Popular Electronics*, into the new, exciting and timely monthly magazine – ***Poptronics*** – that you will soon be holding in your hands. Coincidentally it will be the January 2000 issue. What a way to enter the new millennium! (Yes I know the millennium actually starts January 1, 2001.)

It's evolution! Starting with the January 2000 issue *Electronics Now* will become ***Poptronics,*** *the magazine for the hands-on electronics activist!* No matter what your specific electronic interest; ***Poptronics*** will be the magazine for all electronics activists in the 21st Century. We've been here since the beginning, when we began in April 1908 with the first issue of *Modern Electrics.* We're still going to be here for the start of the next millennium, the year 3001, with ***Poptronics*** or its future descendant.

We have brought together all of the very best elements of our existing magazines into ***Poptronics.*** It is designed to deliver to you, our readers the very best editorial variety we can assemble. We have packaged *Gizmo, Prototype, Hands-on Reports, Service Clinic, Peak Computing, Robotics Workshop, Amazing Science and other key columns*; and wrapped them around a main editorial package of construction projects, product lab reviews, how it works and how to do it articles, to create a wonderful new world of electronics!

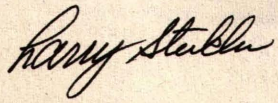
Our web site at www.gernsback.com will still be there too. The forums, searchable index, and links will stay as they are, but you may find a lot of "under construction" signs in other areas. Keep logging in to keep up with what is happening. I believe that you will find it even more useful than before. We will continue the forums that bring thousands of readers to exchange ideas, get questions answered, and find the latest updates on contents in the magazine. It's a great place to search the index for old articles and to download current articles and artwork from the current issue.

If you are a current subscriber to *Electronics Now*, you will automatically receive upcoming issues of ***Poptronics*** (starting with January 2000) until your current subscription is fulfilled. If you also subscribe to *Popular Electronics* we will combine your subscriptions (if you have 10 more issues of *Electronics Now* to go, and 5 issues of *Popular Electronics* – for example – you will receive the next 15 issues of ***Poptronics***).

If we goof and you get two copies of ***Poptronics*** next month, just cut off or copy the labels on the front cover of both magazines and send them to me. I'll see that your subscription is merged without you losing a single copy.

An exciting new world of electronics publishing begins with the January 2000 issue of ***Poptronics***. Be our partner in progress. Stay with us and see just how great our electronics industry can be. We will be bringing you all of the latest electronics news as it happens.

Larry Steckler, EHF,CET
Publisher



Electronics Now

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Popular Electronics®

Poptronics

THE MAGAZINE FOR THE HANDS-ON ELECTRONICS ACTIVIST!

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With this complete setup, you'll always know when there's trouble at home or the office. It calls you at any Caller ID-equipped phone number you select—even a cell phone—if someone breaks in.
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Poptronics (ISSN 1526-3681) Published monthly by Gernsback Publications, Inc. 500 Bi-County Boulevard, Farmingdale, NY 11735. Second-Class postage paid at Farmingdale, NY and at additional mailing offices. One-year, twelve issues, subscription rate U.S. and possessions $24.99, Canada $33.15 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries $33.99. Subscription orders payable in U.S. funds only, International Postal Money Order or check drawn on a U.S. bank. U.S. single copy price $4.99. Copyright 2000 by Gernsback Publications, Inc. All rights reserved. Hands-on Electronics and Gizmo trademarks are registered in U.S. and Canada by Gernsback Publications, Inc. Poptronics trademark is registered in U.S. and Canada by Electronics Technology Today, Inc. and is licensed to Gernsback Publications, Inc. Printed in U.S.A.
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Editorial

That Secure Feeling

Welcome to the first issue of **Poptronics**, the magazine for the electronics activist. As mentioned in our publisher's letter on page 1, this new title represents the merger of our favorite content from *Popular Electronics* and *Electronics Now*, with a few new surprises thrown into the mix. We're determined to have our expanded coverage be your primary source for cutting-edge projects, consumer technology, hands-on computing, and "future-science."

If you want to be a part of modern electronics ... want to remain ahead of the accelerating techno curve, you've come to the right place. Feel free to look over the shoulder of our writers each month and apply what you find. In addition to expanding your knowledge of electronics, our magazine might just include projects and ideas that can improve your day-to-day life.

For instance, to kick off the year 2000, we thought we'd address an area of electronics that's a growing concern for many: Security. It's become the Information Age with a vengeance, and there are more than a few ways that old-fashioned theft and modern computer vandalism can harm us in costly ways. Fortunately, electronics advances have also made it easier for those in the know to protect themselves and their privacy.

Our *Caller-ID Alarm System* is a great overall way to protect your home and valuables. Should someone try breaking in, the circuit will call you at any Caller ID-equipped phone you choose (even a cell phone for those on the go). You can then call the cops and have matters resolved, all without costly monthly monitoring. The story begins on page 15.

On the computer front, this month's *PC Tech* section contains a feature detailing hardware and software that can keep your data and even PC safe. For this and other cutting-edge coverage, turn to page 39.

What about your car? Forget about complex alarm systems that are a nightmare to install. Use the *Watchdog*, and its five-minute setup, to protect your car or truck. Check it out on page 23.

Finally, to guard just about anything under the sun, consider adding the *Electronic Padlock*. One day, hopefully soon, we'll all do away with keys and rusty locks and use this and similar devices on doors, ignition systems, and even power switches. Learn more about this lock on page 30.

But security stories are only part of our premiere issue. Scan the Table of Contents and you'll be certain to find an exciting selection of departments you can really dig in to. From robotics to voice-recognition circuitry, from servicing info to musings on all things technical, from gizmos to audio/video reviews, we've got you covered.

Konstantinos Karagiannis
Editor

Poptronics®

Larry Steckler, EHF, CET, editor-in-chief and publisher

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Since some of the equipment and circuitry described in POPTRONICS may relate to or be covered by U.S. patents, POPTRONICS disclaims any liability for the infringement of such patents by the making, using, or selling of such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

GIZMO®

Mini DV Viewcam

Sharp Electronics' *VL-SD20U mini DV Viewcam* weighs in at less than 1.25 pounds (without battery pack or cassette), measures just 6.4 × 3.8 × 2.9 inches, and costs under $1000. The digital Viewcam fits in the palm of a hand and slips inconspicuously into a purse or briefcase.

The VL-SD20U sports a three-inch color LCD screen with low-light reflectivity (one percent) for improved picture quality. It absorbs 99 percent of all reflective light, allowing it to be used both indoors and outdoors. The viewscreen boasts 660,000 pixels and offers up to 500 lines of resolution. The LCD rotates for self-record mode.

Sharp's "Digital Gamma Brightness Correction" circuit is said to significantly improve the quality of the video being shot against a backlit subject. The technology minimizes wash-out by automatically darkening the background light and brightening the subject.

In photo mode, the mini DV camcorder uses "Still Frame Technology" to faithfully capture even fast-moving objects in still shots that are free from video noise. IEEE-1394 technology lets users transfer images between the Viewcam and a computer almost instantaneously, as long as the latter is equipped with a 1394 port.

Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; 800-BE-SHARP; *www.sharp-usa.com.*

CIRCLE 50 ON FREE INFORMATION CARD

Playing Tag

The *Dymo LetraTag* electronic labeler ($29.99) from Esselte is aimed at consumers who are trying to get organized. It can be used to organize crafts projects, schoolbooks, workshop tools and supplies, and kitchen cupboards, as well as home offices.

The brightly colored label maker features a color-coded keyboard, built-in tape cutter, and split-back easy-peel tapes. The tapes are available in paper, plastic, or metal, in a wide range of colors, and even some seasonal and special-occasion themes. The LetraTag's ergonomic design allows easy handheld operation and lets the unit rest at an angle for easy keyboard access on flat surfaces. An LCD readout lets you preview the label before printing it.

Esselte, 599 West Putnam Avenue, Greenwich, CT 06830; 203-661-9700; *www.dymo.com.*

CIRCLE 51 ON FREE INFORMATION CARD

Kaboom Box

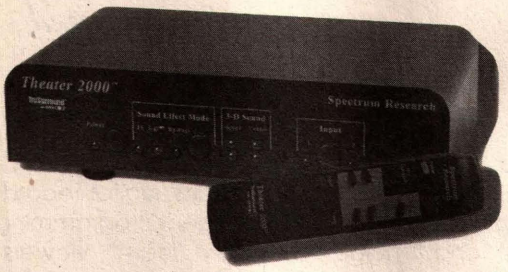
The *RV-B99 Kaboom Box* ($330) from JVC Company of America is a cylindrical portable music system that's available in two-toned black/silver or gray/black. The CD/cassette/radio is equipped with a 1/4-inch jack for a guitar/mic input with level control, allowing users to play or sing along with favorite songs.

The Kaboom Box features JVC's Super Exciter Bass Circuit, a compressor unit that intensifies low frequencies for deep, lifelike bass. Its Active Clear Sound circuitry, which becomes active only when high-frequency signals are present, is said to control high frequencies to reduce noise and deliver balanced response over the entire audible range.

JVC Company of America, 1700 Valley Road, Wayne, NJ 07470; 973-315-5000; *www.jvc.com.*

CIRCLE 52 ON FREE INFORMATION CARD

Affordable Surround Sound



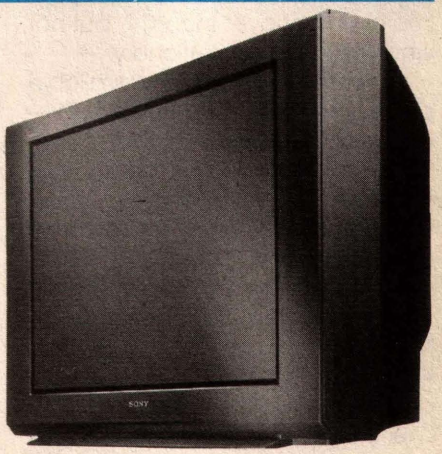
While multi-speaker surround-sound systems are terrific, they don't come cheap. If you'd rather not shell out as much as a grand on enhancing the sound of your movie experience at home, consider Spectrum Research's *Theater 2000* ($169.95, MSRP). Attach just two speakers to it, and prepare to be amazed.

The Theater 2000 uses SRS Labs' patented TruSurround and SRS technologies to bring virtually any sound source to life. After you hook up the unit, you'll feel as if car chases and other movie action sequences are happening right in your living room. Best of all, you'll still have enough money left to buy popcorn.

Spectrum Research, 4370 S. Tamiami Trail, Suite 310, Sarasota, FL 34231; 941-921-3484; *www.theatersound.com.*

CIRCLE 53 ON FREE INFORMATION CARD

Scaled-Down Wega



We're not quite sure when 27-inchers went from being large- to small-screen sets, or when just under a grand became modestly priced, *but*—for videophiles with limited space and/or budgets—Sony has extended its line of FD Trinitron Wega flat-screen televisions to include "small-screen" sizes such as the 27-inch *KV-27FV15* ($949.99). It contains the proprietary FD Trinitron picture tube, whose innovative CRT technology is said to create a vertically and horizontally flat screen. Other picture-improving features include a three-line digital comb filter that analyzes three TV scanning lines at a time, creating a high-resolution image with minimum noise; "Velocity Modulation" scanning that varies the scanning beam speed for accurate picture transitions; and "Vertical Aperture Compensation" for sharp edge details.

The KV-27FV15 offers an automatic volume control that equalizes the volume levels between programming and commercials. The set's Sound Retrieval System (SRS) creates a wide, three-dimensional effect from its two "Dynamic Acoustic Chamber" speakers and provides Virtual Dolby Surround sound.

The 27-inch Wega provides two-tuner picture-in-picture. Favorite Preview allows you to preview five favorite channels without having to leave the program you're watching, and Speed Surf allows you to press and hold the up/down buttons on the illuminated remote to race through hundreds of channels at high speed.

Sony, 1 Sony Drive, Park Ridge, NJ 07656; 800-222-SONY; *www.sony.com.*

CIRCLE 54 ON FREE INFORMATION CARD

It's Multiplying!

The *PhoneMate MA-240* multi-handset phone system from Casio is multiplying, that is. The basic system ($199) contains a two-line, digital 900-MHz base and one handset. The base unit, however, can support up to 11 additional MH-200 handsets ($99 each). Those handsets, which are smaller than some cell phones, require only AC power—no phone jacks. Each of the additional handsets comes with a small charging cradle that plugs into an AC wall outlet. That means they can be placed in any room in the house or small office, even where no jacks are available.

Digital Time Division Multiple Access (TDMA) 900-MHz technology allows up to a dozen handsets to be used in close quarters without interference. The MA-240 system allows convenient handset-to-handset intercom calls as well as call conferencing and call transfer. Both the handset and the base unit display Call Waiting and Caller ID numbers on LCD readouts.

Casio, PO Box 2914, Torrance, CA 90509; 310-618-6821; *www.casio phonemate.com.*

CIRCLE 55 ON FREE INFORMATION CARD

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A Hands-on Electronics® REPORT

Digital Video Recorders—Head to Head

Philips TiVo and ReplayTV provide truly customized video viewing and digital recording.

There's been a lot of talk lately about HDTV and the coming digital television (DTV) revolution, but for most of us it's been just talk. Our closest brush with digital video technology has been with the DVD player—a significant improvement over the VCR, but not what we'd call revolutionary.

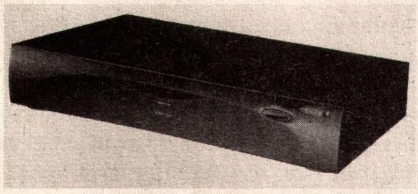
However, two currently available products—*TiVo* and *ReplayTV*—can legitimately make that claim. Both are set-top boxes that fall into the general category of Digital Video Recorder, or DVR. Outwardly resembling a VCR (minus the cassette compartment), they are, in fact, computers equipped with an MPEG-2 chip for video compression, a hard drive for video storage, and an interactive program guide. Like a VCR, they are capable of making time-shifted recordings of your favorite shows. But that's just the beginning.

Smart Recording. DVRs are also being called Personal TV Recorders or Personal Video Recorders (PTR or PVR—can't have a new technology without a host of new acronyms!). That's because their coolest features are those that let you take total control of your viewing environment. Here are a couple of examples:

Do the kids' bedtime stories routinely stretch into the first ten minutes of *Frasier*? No problem. Record the show at 9:00, come down at 9:10, and start watching from the beginning. The DVR will keep recording the remainder of the show as you watch it in its entirety. Fast-forward through the commercial breaks, and before you know it you'll have caught up with the real-time broadcast.

Like home-improvement shows? Don't have the time or inclination to peruse the TV Guide to hunt them all down for recording? Let your DVR search them out and record them for you—automatically. Ditto for movies and shows featuring a certain actor, or all of your favorite teams' games. In fact, these machines can learn about your viewing tastes and make independent decisions to record shows that they think you might enjoy!

Miss a touchdown pass? Want to take another look at a controversial play? Just use the instant replay feature and see for yourself if the ref's call was a good one. Fast-forward through the next set of commercials, and you'll be back in real time again.



ReplayTV offers quality recording of shows and movies, as well as free access to the monthly Channel Guide, which lets the unit intelligently find content you're interested in watching.

These features are not merely convenient; they can change the very face of TV viewing—and perhaps TV broadcasting as well. Why not *intentionally* start to watch *Frasier* at 9:07 and use the DVR to bypass the commercials? With ads now taking up 16 minutes per hour during prime time, you'll still get to see the whole show by 9:30, and you'll have saved seven minutes of your valuable time. Of course, you also will have bypassed seven minutes of NBC's valuable advertising time, which is why some industry analysts are predicting that DVRs could spell the end of free TV as we've known it.

TiVo and ReplayTV are similar in that each provides digital recording and an intelligent programming guide that can "learn" viewers' preferences. They are comparable in looks, price, and storage capacity. Both systems store compressed video (from cable, satellite, or antenna) onto a hard drive and provide buffers that allow users to watch from the beginning a show that has already started to be recorded—and to pause, fast-forward, or rewind "live" programs. Both offer several recording modes with different levels of compression. Both use the telephone line for initial setup and to download program information on a daily basis. Neither serves as a long-term archiving device; recordings that you want to save can be downloaded to a VCR.

But there are several key differences between the way the two DVRs function and in some of their features. Let's take a look at what each one has to offer.

ReplayTV. Replay Networks' offering is available in three different versions. In its standard recording mode, the *2001*, which costs $699, can store about 10 hours of video; the *2003* version ($899) can store about 14 hours; and the dual-drive *2004*, priced at $1499, can hold up to 28 hours. The good news is that even in standard mode (lowest video quality, maximum compression rate), ReplayTV records at 400 lines of resolution, comparable to S-VHS. Lower the compression rate and the video quality improves—to an impressive 480 lines of horizontal resolution—but the storage capacity decreases.

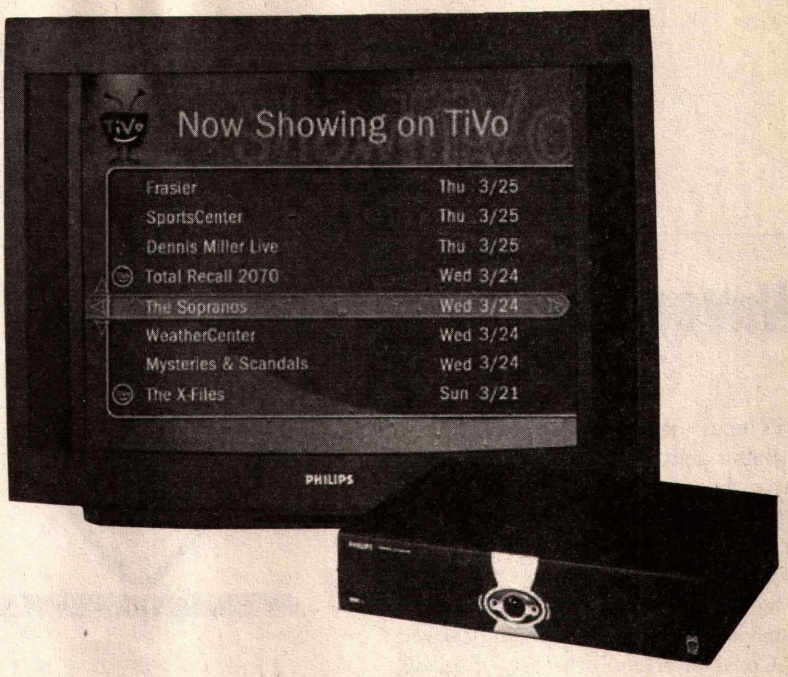
The set-top box is connected between the cable box, antenna, or satellite receiver and the TV, and plugged into a phone jack to

enable program information to be downloaded. Any time you watch a program, it is being automatically recorded and temporarily stored in the unit's buffer. That buffer (which holds up to four hours of programming, depending on how much disk space is available on the hard drive) is what allows you to treat live TV as if it were a videotape. But to record a show for prosperity, you must tell ReplayTV to do so, using the onscreen guide.

ReplayTV charges no monthly service fee for its intelligent, interactive programming guide. The Channel Guide shows seven channels divided into half-hour segments per screen. For each program, a plot summary and actors' names are available (although there's no indication if a show is a rerun). If you want to record a show, select it on the guide and press a button on the remote. If it's one of your favorite programs, you can opt to "record all episodes" instead of just one. And you can begin to create personalized "Replay Channels."

If, for instance, you chose to record *Law & Order* every week, ReplayTV would automatically create a "*Law & Order*" channel. Even better, you can have ReplayTV automatically store all programs featuring a certain actor or theme in other Replay Channels. Ask ReplayTV to search for programming including Tom Hanks, and it would search all available programming to come up with movies (*Forrest Gump*, *Philadelphia*), old reruns of *Bosom Buddies*, and even *That Thing You Do!*, which Hanks directed. You can view an onscreen list of Replay Channels and make your viewing selections directly from it. Perhaps your list might include gardening, NY Giants, and *The X-Files* channels. And, when you go to replay a show, you can bypass commercials using ReplayTV's 30-second Quick Skip function.

ReplayTV tells you precisely how much recording time remains. Recordings are stored for only a few days and then automatically deleted, to prevent the hard drive from running out of space, but you can connect a VCR to the DVR to archive any programs you plan to keep. And ReplayTV's back panel features an IEEE-1394 FireWire port that is expected, sometime down the road, to allow you to connect an expansion module that will "increase dramatically the number of hours of TV programming that ReplayTV can store."



TiVo learns about your preferences and can even pick shows for you to watch. Like ReplayTV, TiVo records video in MPEG-2 format on a hard drive.

TiVo. Philips offers two models of TiVo: In "Good" (most highly compressed) mode, the *HDR112* ($499) provides up to 14 hours of recording time, and the *HDR312* ($999) can hold up to 30 hours. Yes, those prices seem less than those of ReplayTV, but TiVo charges for its program guide. You can pay $9.95 a month or buy a lifetime subscription for $199—which would bring the price of the base model in line with that of the ReplayTV model 2001.

TiVo offers four different levels of compression: good, medium, high, and best. Recordings made in "good" mode have a resolution of just 230 lines; "best" mode provides 430 lines of horizontal resolution. Good is adequate for time-shifting soaps and sitcoms, but for fast-action movies and sporting events you'll want to use best quality mode.

The TiVo program guide is not the standard grid used in print guides (and by ReplayTV), and it takes a bit of getting used to. It's divided into three portions. Across the top, it describes the program currently showing. The bottom left side is a scrollable list of all shows currently on, while the right side lists the seven shows coming up next on the current channel. The onscreen guide is a translucent box that allows you to view video behind it.

As with ReplayTV, recording a show is a simple matter of pressing a button on the remote. But TiVo has a different way of personalizing your viewing experience. It doesn't perform searches by theme or actor—although (unlike ReplayTV) it does allow *you* to search for shows by title using an onscreen keyboard. The unit lets you rate shows, and uses your input to "learn" your preferences.

TiVo provides "thumbs up" and "thumbs down" buttons on the remote control. You can assign between one and three ups or downs to a show you're watching (or any show that appears on the guide) to indicate how much you like it. Just opting to record a show gives it an automatic thumbs up. Then it puts that insider's information to use and takes the initiative

(Continued on page 38)

Prototype

Waves That Return to the Past

It's no use crying over spilt milk, as the saying goes. To err may be human, but in the world of wave mechanics, the clock can be turned back; spilt milk can be returned to the saucer. This phenomenon is called a time-reversal wave, and it can be applied to light waves, ultrasound waves, or any other kind of wave.

Consider a uniform set of plane waves. As the waves travel along, they meet various boundaries, which reflect and refract the waves. If the surfaces of these boundaries are perfectly flat, the waves retain their original shape and maintain their original course, but if they are at all irregular the waves' shape becomes distorted and their path deviates. Thus, images transferred on these waves are also distorted.

The easiest way to understand this concept is to consider familiar optical images. Imagine you are looking down on a fish swimming in a pond. As long as the pond surface is perfectly still, the image of the fish is clear, but as soon as a ripple passes over the pond the image becomes distorted, because light rays are refracted as they pass through the broken water surface.

Conventional wisdom would have it that once an image is distorted, it cannot be returned to its pristine form. However, the original image can be restored by using a time-reversal wave.

A time-reversal wave, or phase-conjugate wave, is a wave that has the exact same wave pattern as another wave but is moving in the exact opposite direction. In other words, they are twin waves, whose only difference is that one is right-handed and the other left-handed. The name "time-reversal wave" comes from the fact that this wave behaves like the rewind function on a video player, in effect taking an image back in time. Even if a clean wave becomes distorted by traveling through some disturbance, the wave can be returned to its original wave pattern by converting it to a time-reversal wave and retracing the same path back through the disturbance. The device that can convert an incident wave to a time-reversal wave is called a phase-conjugate mirror.

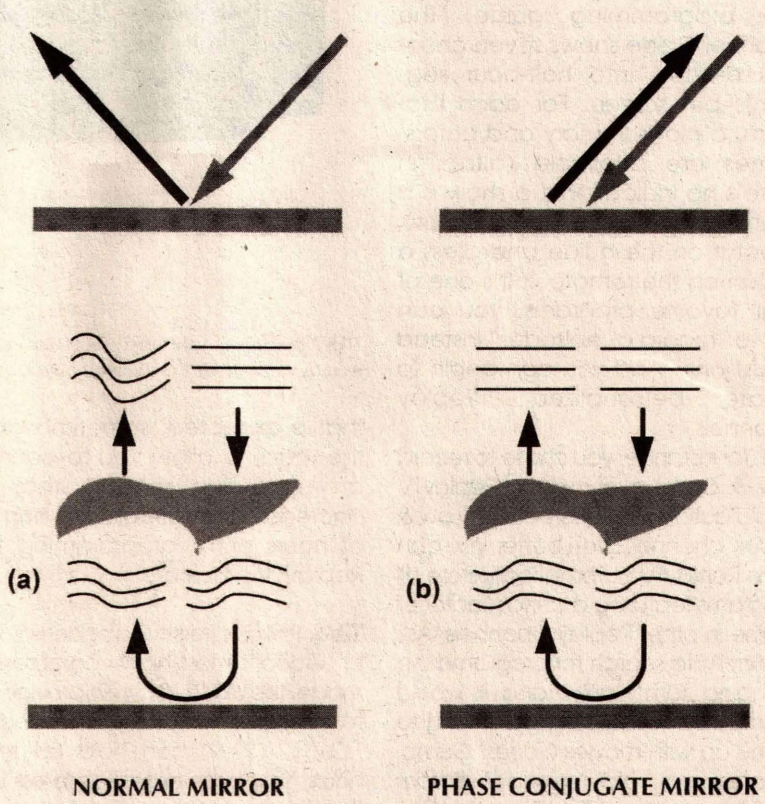


Fig. 1. Reflections off a regular mirror (left) and a phase-conjugate mirror (right).

Figure 1 compares how waves are reflected off a normal mirror (top left) and a phase-conjugate mirror (top right). The lower diagrams in Fig. 1 show what happens when an object with an uneven surface is placed between the wave origin and the mirror. In the case of a normal mirror (left), the distortion is amplified, whereas the phase-conjugate mirror (right) actually eliminates the distortion. When the time-reversal wave generated by the phase-conjugate mirror passes back through the wavefront disturber, this new distortion exactly cancels out the first distortion of the wave pattern, thereby restoring the wave to its plane wave state. (To understand how this works, compare the different wavefront of wave a and wave b.)

Ultrasonic Images

When we think of images, we usual-

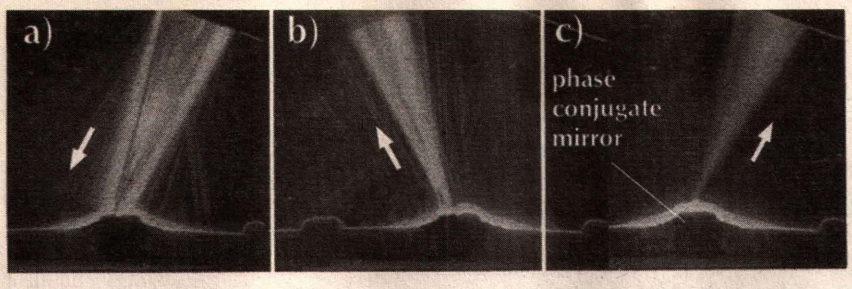


Fig. 2. Frames from a slow-motion videotape of a time-reversal wave. In a) is shown convergent ultrasound waves entering the phase-conjugate mirror; in b) a normal reflection off that same mirror is shown, and in c) you see an image of the time-reversal wave.

ly think of optical images, but optical images only show us the exterior of objects. Ultrasonic images, however, reveal the interior of objects that cannot be penetrated by light. Ultrasonic diagnostic equipment is now found in essentially all hospitals, and ultrasound is also widely used as a non-destructive method of finding flaws and breaks in rails and other materials. Another reason for the popularity of ultrasound is that ultrasonic waves pose far less danger to the human body than do X-rays.

Distortions as discussed above also occur frequently in ultrasonic images. These distortions, too, can be eliminated through the use of time-reversal waves.

The phase-conjugate mirrors used for ultrasound are made of piezoelectric ceramics. Originally, these materials were used for the emission of ultrasonic waves, so their use in phase-conjugate mirrors represents a highly specialized application. A phase-conjugate mirror is made of a rectangular piece of piezoelectric ceramic material that measures 1cm × 1cm × 5cm. Silver electrodes are soldered on to opposite sides. The top of the mirror is irradiated with an ultrasonic wave with a frequency of *f*Hz (around 10 MHz). Simultaneously, an alternating voltage twice that (2*f*Hz) is applied to the electrode. When this occurs, a time-reversal wave is emitted from the top of the mirror.

Although this device is referred to as a mirror, the sound wave is not reflected off its surface, but enters the device and is re-emitted after a slight delay. This special device is based on the Schlieren technique. If the time-reversal wave is filmed in slow motion, its unusual behavior can be seen with the naked eye. Figure 2 shows three frames of such a film.

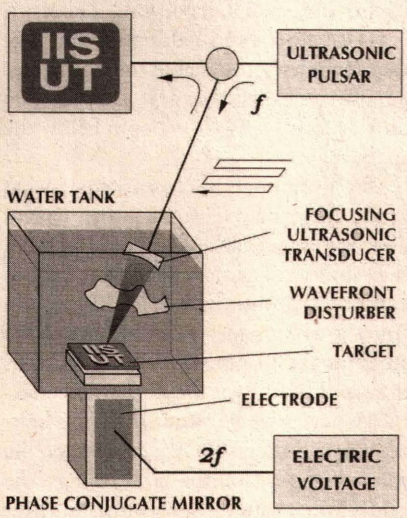


Fig. 3. In this diagram of ultrasound imaging equipment, a stainless steel plate inscribed with the initials of the Institute of Industrial Science, University of Tokyo (IISUT) is placed between a phase-conjugate mirror and a convergent ultrasonic vibrator. An irregularly shaped object (made of agar) was placed between the ultrasound source and the target in order to distort the ultrasonic waves.

How Time-Reversal Waves Are Produced

The piezoelectric effect is the phenomenon whereby voltage is converted to energy and vice versa. Generally, voltage is proportional to energy, but there are some nonlinear piezoelectric materials where the conversion is not proportional, but multiplicative instead. The sum of a voltage of 2*f* and an energy (ultrasound) of *f* produces a time-reversal wave of -*f*. Piezoelectric ceramics made primarily of lead zirconate or lead titanate are prime examples of materials that fit this equation.

Generally, an ultrasonic image is generated by bouncing convergent ultrasound waves off an object and picking up the reflected signals, as shown in Fig. 2. The focus of the ultrasonic waves scans through the object on a zigzagging path, and the reflected waves are displayed on a monitor like the scanning lines of a television broadcast. The difference in the intensity of the reflected waves produces an image of the inside of the object.

Figure 3 is a diagram of ultrasound imaging equipment including a phase-conjugate mirror. The phase-conjugate mirror is attached to the bottom of the water tank. A convergent ultrasonic vibrator is positioned above the tank. The test material is a stainless steel plate inscribed with the initials of the Institute of Industrial Science, University of Tokyo (IISUT). An irregularly shaped object (made of agar) was placed between the ultrasound source and the target in order to distort the ultrasonic waves. When the electric voltage to the phase-conjugate mirror is turned off, a normal ultrasonic image is produced; but when the mirror is turned on a time-reversal ultrasonic wave image is produced. Figure 4 shows what these two images look like. The initials in the normal ultrasonic image (on the left) are distorted so much that they can hardly be read, while the initials in the time-reversal wave image on the right are clear. — TAKAGI KENSHIRO (COURTESY OF LOOK JAPAN, MARCH 1999) PT

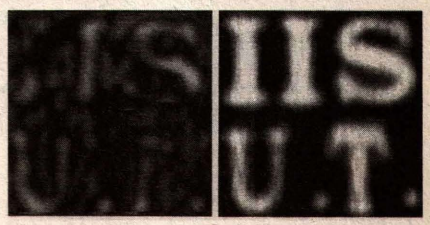


Fig. 4. The initials in the normal ultrasonic image (on the left) are distorted so much that they can hardly be read, while the initials in the time-reversal wave image on the right are clear.

Biosensors: Detecting Contaminated Meat

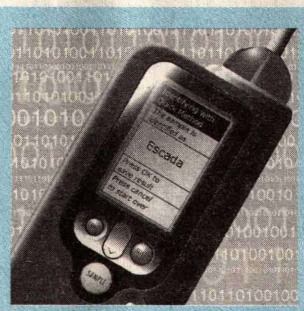
Recent incidents of contaminated meat in grocery stores and restaurants have heightened consumer concern. A new bacterial sensing device called a biosensor was developed at the

What's That I Smell?

Hewlett-Packard Company has signed a collaborative research agreement with Cyrano Sciences, Inc., a company that uses chemical sensors on a silicon chip to mimic receptors in the human nose. Under the terms of the agreement, the companies will work together to develop Cyrano's proprietary sensor technology into products for a variety of markets.

The goal of the collaboration is to produce a portable, inexpensive and rugged handheld "electronic nose" based on an array of chemical sensors composed of conductive polymer composites. Such a product could be used in the medical, food-processing, and chemical industries to detect and classify a broad variety of volatile compounds. The electronic nose could allow food companies to continually monitor batch-to-batch consistency. For chemical companies, a portable tool could be used for efficient detection of leaks in pipelines and storage containers, in contrast to current monitoring techniques that are resource-intensive and cumbersome. The product might also be used to diagnose illnesses, including infections and metabolic conditions.

This technology could evolve into consumer product applications. An electronic nose could be integrated with household appliances such as refrigerators to detect and alert for spoiled food or in microwave ovens to indicate when food is cooked properly. Additionally, emergency crews could use a handheld product to profile hazardous materials sites, allowing them to select the appropriate fire retardant, containment strategies and protective gear. PT

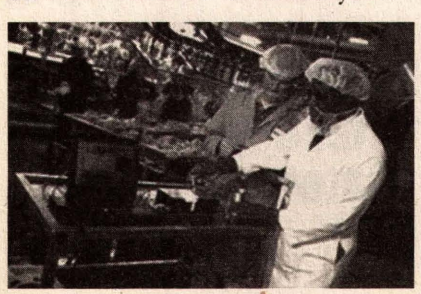


This portable handheld electronic nose from Cyrano Sciences could have applications in many markets.

Georgia Tech Research Institute (GTRI) and is currently being field-tested. It can simultaneously identify species and determine concentrations of multiple pathogens—including the deadly E. coli and Salmonella—in food products in less than two hours while in operation on a processing plant floor.

Tests for bacterial pathogens in meat are currently not required by federal or state food industry regulators. A few large companies perform lab tests, but they are costly and slow—sometimes not even yielding results for 48 to 72 hours.

Georgia Tech researchers—in collaboration with Dr. Robert Brackett, a professor at the University of Georgia's Center for Food Safety and Quality Enhancement in Griffin—have been developing and testing the biosensor in their laboratories for about four years.



Researcher Dr. Paul Edmonds, right, tests a biosensor at a Georgia poultry plant.

Laboratory tests have proven the biosensor is extremely sensitive, meaning it can detect pathogens at minute levels of 500 cells per ml. Researchers believe they can improve that sensitivity to 100 cells per ml. Current laboratory methods only achieve sensitivity levels of 5000 cells per ml, and they usually take from eight to 24 hours to yield results. In addition, lab equipment costs $12,000 to $20,000 per instrument compared to an estimated $1000 to $5000 for a biosensor.

The biosensor can simultaneously detect 12 different pathogens, but researchers are concentrating on six bacterial species for now, including Salmonella and E. coli. All of these pathogens are associated with stomach illness in humans. When detected, they are usually found in meat, but sometimes occur in produce.

"If pathogens are found with the biosensor, then food processors can make decisions more quickly about applying treatments, such as antiseptics," said Dr. Paul Edmonds, a professor of biology at Georgia Tech. "Or they might divert those products to cooking operations, which could kill the pathogens. And companies could modify their sanitation plans."

Meanwhile, the integrated optic interferometric sensor technology upon which the biosensor is based has already been patented by Niles Hartman, a biosensor developer and senior research engineer at GTRI and the Georgia Tech Research Corp. It is also the basis for a chemical contaminant sensing system called E-SMART. That system is also undergoing field tests. The chemical sensor was licensed commercially by the Atlanta-based company Photonic Sensor. PT

Is There Life Down There?

In September, researchers conducted an experiment at Yellowstone National Park, WY, in an effort to find tiny multi-cellular organisms that may be living in the Hot Springs. Conventional wisdom says that only single-celled life, such as bacteria, could exist in Yellowstone's boiling waters, according to scientists at NASA's Ames Research Center, Moffett Field, CA.

The main tools that Jonathan Trent, team leader of the Ames Yellowstone expedition, and his team used were two special "baitable" salt shaker-size video cameras built by Deep Sea Power and Light, Inc., San Diego, CA. The cameras are in a NASA-designed package that includes sensors able to detect temperature, acidity, oxygen, and carbon dioxide levels, as well as depth below the surface.

"Part of our ability to anticipate what kind of life may exist on other worlds depends on expanding our knowledge of the ability of Earth life to adapt to extreme conditions," said Trent, an Ames astrobiologist. Astrobiology is the study of the origin, evolution, distribution, and destiny of life in the universe.

"As far as we know, nobody has baited video cameras to try to attract life forms living within the Hot Springs," he said. "We baited our 'mini-monster cams' with local food, such as insects, algae or leaves—things that normally fall into the spring."

A rope was stretched across each hot spring being investigated and the camera and instruments were slowly lowered into the middle of each pool of hot water. Wires carried computer signals and TV pictures to the surface where

scientists recorded data and images.

In other efforts to prepare to search for extraterrestrial life forms, investigators across the world have been looking for living things that exist under extreme conditions. Those conditions include extremes of heat and cold. Scientists have found single cell archaea growing at temperatures as high as 234 degrees Fahrenheit.

"By increasing our knowledge of the physical and chemical limits that are favorable to life, we'll expand the possibility of predicting where complex extraterrestrial life forms may exist," Trent said.

Scientists at the Ames Sensors 2000! Project were assigned to develop a probe housing and electronics capable of surviving the boiling water, and yet able to detect and transmit data. "The real challenge has been to develop a probe that can survive in extreme environments of boiling, acidic water," said Fred Martwick, an Ames Sensors 2000! lead engineer for the Yellowstone project. PT

Optical Networks

Chorum Technologies Inc. has introduced its PolarWave family of advanced optical products for terabit-scale active optical networks. PolarWave's optical switching, routing, and processing technologies dramatically increase the performance, reliability, and capacity of advanced optical networks.

"Using our products and technologies, a new generation of optical networks can be built, where hundreds of channels are dynamically routed, switched, and managed optically, without costly and bandwidth-limiting optical-to-electronic-to-optical conversions," said Scott Grout, Chorum president and CEO.

The PolarWave family of products is comprised of five product lines: Optical Slicers, DWDM Routers, Optical Switches, Optical Processors, and Integrated Optical Systems. Optical Slicers perform advanced optical filtering, called interleave filtering. By using Optical Slicers in long-haul DWDM networks, optical system manufacturers can transmit terabits of information on a single fiber.

DWDM Routers are high-performance all-optical multiplexers and demultiplexers. With Chorum's DWDM Router products, it is now possible to build modular, passive optical multiplexing and demultiplexing systems that support hundreds of channels at data rates of 10 Gbps and higher. Their line of Optical Switches is based on liquid crystal technology.

With new networks supporting dynamic routing and switching of optical channels, signal conditioning is critical. In addition to each of the product lines, the technologies can be combined to form powerful integrated products. Chorum's Integrated Optical Systems couple switching, filtering and/or processing technologies together for advanced applications, such as optical add/drop multiplexing (OADM) or optical cross-connects (OXC). PT

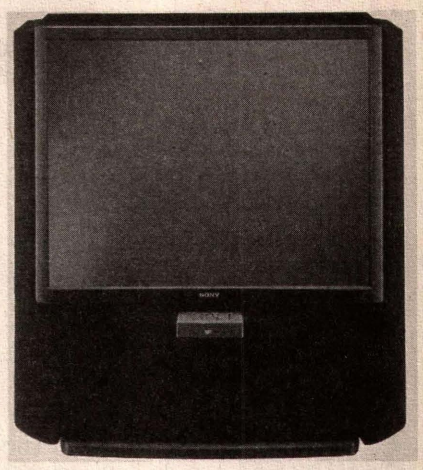
Large-Screen TVs

Sony is changing the look of analog (NTSC) and high-definition (HDTV) programs with the introduction of two new Hi-Scan big-screen TVs. These rear-projection TVs feature Sony's second-generation Digital Reality Creation (DRC) technology for near high-definition pictures from standard definition sources, and a newly designed, high-performance display for viewing HDTV programs.

The 53-inch KP-53XBR300 and the 61-inch KP-61XBR300 big-screen televisions are the first to incorporate the latest generation of DRC technology, a proprietary technology that converts analog signals to near high-definition quality, resulting in clean, sharp images. DRC technology bit-maps the original NTSC and standard definition (480i) signals in real-time, doubling the vertical resolution and increasing horizontal pixel count two times, creating an image with 960i ×1440 pixels.

When paired with a digital television (DTV) set-top decoder box compatible with HD component connections, the new Hi-Scan TVs will have the ability to display 480i/480p plus high-definition signals at 1080i resolution.

Sony's Hi-Scan televisions include such other enhancements as an Extended Definition CRT and optimized positioning of the Velocity Modulation coil, both of which contribute to improved picture quality. Additional picture enhancements include an advanced Flash Focus full digital auto convergence feature that automatically aligns the picture tubes in just five seconds. A newly designed Lenticular screen along with other screen improvements allows for clear viewing from any angle, while providing higher contrast and less surface glare. PT



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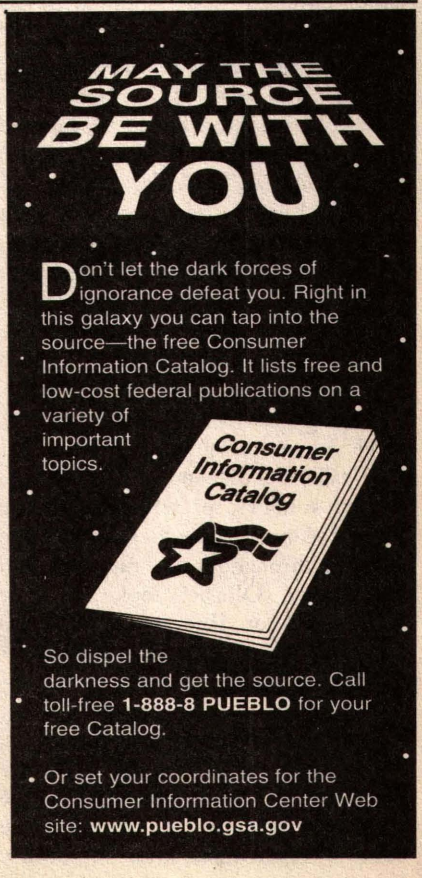
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Q & A

READERS' QUESTIONS, EDITORS' ANSWERS
CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

Joystick-Port Voltmeter

Q *I'd like to make a voltage meter out of my PC's joystick port. I've tried something with resistors and a transistor without success. Does anyone have a schematic for a joystick-port-to-voltmeter adapter?—Pekka Paalanen, Finland*

A Many PCs have input ports for games that use joysticks, which use 0—200,000-ohm variable resistors. To sense the positions of two joysticks, the PC measures the resistance of four resistors; the basic internal circuit is shown in Fig. 1. First the PC removes the short circuit across a capacitor by turning the transistor off, then measures the time that the capacitor takes to charge up to a set level. You can access that reading with the STICK function in QBasic or the appropriate system calls under Windows.

To measure a resistance, you simply connect it across the appropriate pins of the joystick port. I've had fun doing that with thermistors and cadmium-sulfide (CdS) photocells.

Measuring a voltage is harder; you need to replace the resistor with a voltage-controlled current source. The circuit shown in Fig. 2 fills the bill. It was originally published in *PC Techniques*, April/May 1994, and is reproduced here by permission. You must use an op-amp whose common-mode input-voltage range includes ground; the classic LM324 works well. The op-amp must be powered from a 9-volt battery (or from the 12-volt power source inside the PC) so that its output can go all the way up to 5 volts.

Listing 1 shows a QBasic program to make voltage measurements. You must first calibrate the apparatus with two known voltages, preferably near the ends of its range; then you can measure voltages throughout the range. If you don't have QBasic, look on your Windows95 or Windows98 CD; it's there, though not normally installed.

The joystick port has only 8-bit resolution, giving values from 0 to 255. For more accurate voltage measurements, use a serial analog-to-digital converter interfaced to your printer port. See the Q & A column in the October 1996 issue of **Electronics Now** for details. Reprints of that and other issues are available from the Gernsback Reprint Bookstore.

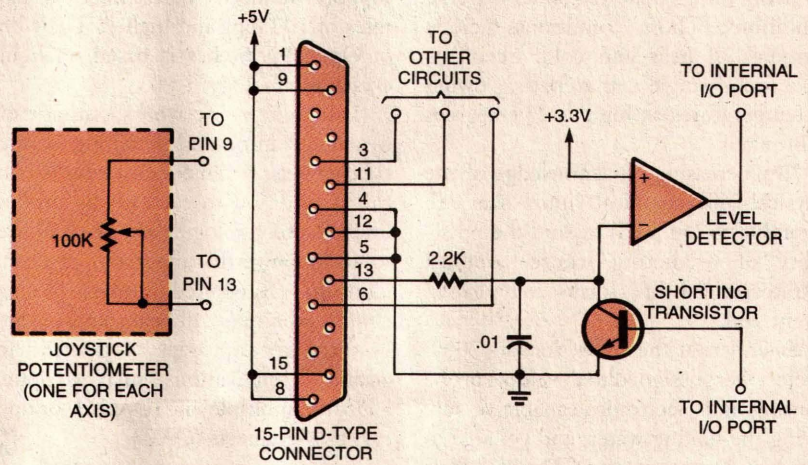

Fig. 1. To measure the resistance of a PC joystick, the computer measures the time taken to charge a capacitor after a short is removed.

Reading PICs With NOPPP

Q *How can I use the NOPPP to read back the contents of a programmed PIC microcontroller?—M. H., East Gosford, N.S.W., Australia*

A NOPPP, the "No-Parts PIC Programmer," was featured in the September 1998 issue of **Electronics Now** and is available in kit form from Ramsey Electronics and Oatley Electronics. It programs PIC16F84 and PIC16C84 microcontrollers. For full information and free software, see NOPPP's Web page: *www.CovingtonInnovations.com/noppp*.

To read back the contents of a programmed PIC, unpack and install the TOPIC software package that is bundled with the NOPPP. The base software for the NOPPP doesn't read PICs; TOPIC, written by David Tait, does. Then use the command:

topic /d myfile.hex

to dump the contents of the PIC onto myfile.hex.

To see what you've got, use MPLAB, Microchip, Inc.'s free PIC development software. With no projects open, choose *File | Import | Download to memory*. Specify the name of your .hex file and MPLAB will import it. Then go to *Window | Program Memory* to look at the program in assembly language. Naturally, there will be no comments or named variables, but you'll be able to see the machine instructions. Some of them may decode incorrectly because MPLAB doesn't know the context; make sure MPLAB is set for the right kind of CPU. You can use the Windows Clipboard to copy the program to a text file.

Base-3 Arithmetic

Q *I'm a high-school junior and an avid reader of your magazine. I'm trying to make a counter circuit that will count in base 3. I've tried using a CD4040 counter chip but don't know how to translate the results into base 3. Any ideas? I've looked into Tri-state buffers, but I'm not quite sure how to use them for three-valued logic.—R. W., Pensacola, FL*

A Rather than generate binary numbers and translate them into base 3, it's easier to use CD4017 counters with output Q3 (pin 9) connected to the reset line (pin 15). The result is a counter that goes through three states, with Q0, Q1, and Q2 high, respectively. The carry output (pin 12) won't work because the CD4017 must count to at least 5 in order to produce a signal there, but you

can probably work out a way to use the Q3 output for carry as well as for reset. If you do that, the pulse on Q3 will be quite narrow; it lasts only long enough to reset the chip that is generating it. You should probably stretch the pulse by putting a monostable between the output of Q3 and the two inputs that the reset pulse is to be sent.

How to represent three-valued logic in digital circuitry is a more difficult question. "Tri-state" buffers aren't much help because their three states are "high," "low," and "disconnected." Since digital circuits sometimes substitute a valid logic level for a missing one, it's hard for the next stage to distinguish "disconnected" from one of the others. You might have more success using op-amps as analog-level detectors. In any case, three-valued or multiple-valued computation is worth exploring.

Origin Of "Ham" Radio Term

Q *Some time ago I read that ham radio gets its name from the initials of three operators, H, A, and M. Can you give me more details on this issue?—F. F., Sao Paulo, Brazil*

A Many people nowadays think "ham" must be an abbreviation because so many other technical terms are—but it isn't. All of the dictionaries that I've consulted agree that "ham radio" is derived from "ham actor" (amateur actor), probably because the earliest radio hams transmitted entertainment to the public—a practice that is now prohibited. "Ham actor" in turn derives from one or more songs in nineteenth-century minstrel shows, "The Ham-Fat Man" or "The Ham Tree."

Since the 1970s, a story has been circulating that "ham" is an abbreviation for the names of three people or maybe three ships, but the story can't be substantiated; it does not seem to have appeared until long after the events in it supposedly took place.

Slotless PCs?

Q *Here's something I've thought about: Do away with internal PC card slots and make all card slots external. A recent article in* NASA Tech Briefs *suggests a slotless computing environment. Is anyone develop-*

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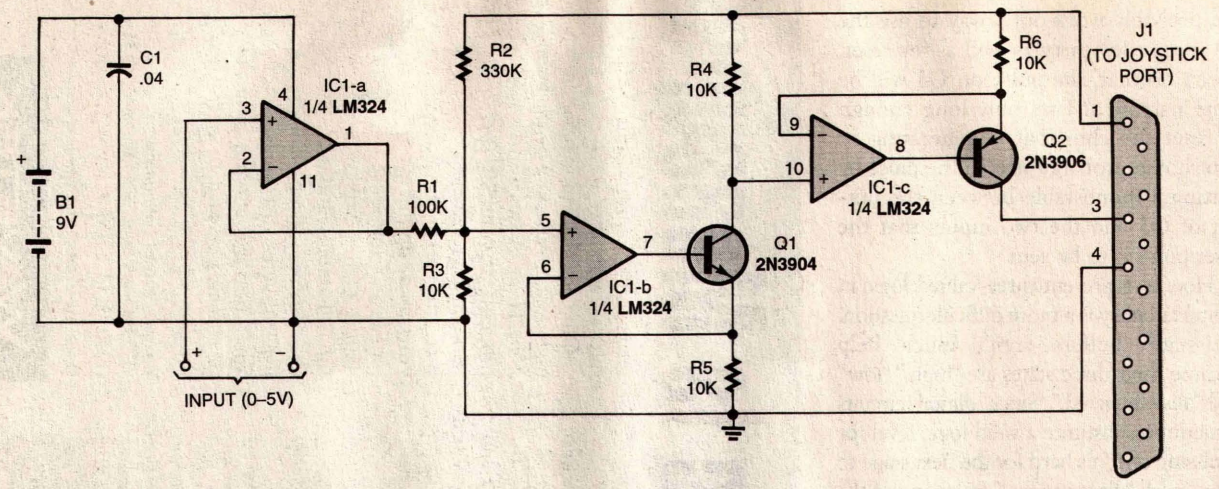


Fig. 2. This circuit will let you use a PC joystick port as a voltmeter in conjunction with the program given in Listing 1.

ing anything along these lines?—T. R., Woodland Hills, CA

A As you note, that's what USB and IEEE-1394 are for. It is becoming easier to attach scanners, additional printer ports, and other peripherals to computers without opening the case. External buses such as SCSI have supported disk drives and other peripherals for a long time.

Let's review why computers have slots. The reason is speed. Before the Pentium era, the cards in a PC plugged directly into the CPU's bus. Thus, they could communicate with the CPU at full speed, without anything in the way to delay the signal. That was vital for high performance.

Today, the CPU has a separate bus, and the ISA, EISA, or PCI bus runs slower than that of the CPU. Although it is, in essence, an external bus (like SCSI) that happens to be inside the case, it's still a lot faster than IEEE-1394 or USB.

I think that slots are here to stay, but they will be used only for the fastest devices, such as graphics cards and disk controllers. Most people would rather not open a computer's case to install a scanner or external CD drive.

Mouse Solution Found

Q *Reader K. W., of Annapolis, MD, asked about adding a parallel port mouse to his Toshiba T2150CDS because the serial port is connected to his GPS. Why doesn't he buy a PS/2-type mouse and plug it into the mouse port?—Tom Snyder, Los Angeles, CA*

A Good suggestion! I didn't know whether the T2150CDS had a PS/2 mouse port. My own Toshiba laptop (a Satellite 430) certainly does.

LISTING 1

```
' V.BAS  (M. Covington 1994, 1999) -
   QBASIC
' Measuring voltage through joystick port
'
CLS
'
PRINT "Calibration needs 2 known
   values,"
PRINT "preferably near ends of range."
'
OPTION BASE 1
DIM RDG(2), VALUE(2)
FOR I = 1 TO 2
 PRINT
 PRINT "Connect known value "; I;" and
   press any key..."
 WHILE INKEY$ = ""
  RDG(I) = STICK(0)
  LOCATE CSRLIN, 1
  PRINT "Reading: "; RDG(I); "     ";
 WEND
 PRINT
 INPUT "Actual value"; VALUE(I)
NEXT I
'
FACTOR = (1 / VALUE(2) - 1 / VALUE(1))
/ (RDG(2) - RDG(1))
OFFSET = .5 * (1 / VALUE(2) - FACTOR *
RDG(2) + 1 / VALUE(1) - FACTOR *
RDG(1))
'
PRINT
PRINT "Factor =", FACTOR, "Offset =",
OFFSET
'
' Taking readings
'
PRINT
PRINT "Taking readings continuously.  Exit
with Ctrl-Break."
PRINT
'
WHILE 1
 RDG = STICK(0)
 VALUE = 1 / (FACTOR * RDG + OFF-
SET)
 LOCATE CSRLIN, 1, 0
 PRINT USING "#### ####.##"; RDG;
VALUE;
WEND
```

More About Talking Books

Q *I just re-read the Q&A in the June 1999 issue of* ***Electronics Now*** *about slowing down a normal cassette player in order to play the Talking Books tapes distributed by the National Library for the Blind. Your answer about a possible torque/speed problem was right on, but there is more to the story.*

The tapes are recorded on four monaural tracks, like consumer stereo cassettes. So if the half-speed modification were successful, it would still be necessary to use a stereo playback head and channel switching to sort out the four tracks. That's a lot of work to do when a visually-handicapped person can get a heavy-duty player on long-term loan free of charge from a local or regional library.

Incidentally, these machines are maintained by volunteer GE and Bell Telephone engineers and technicians, most of whom are retired. They are often looking for more volunteer help; volunteers need not be connected with GE or the Bell System.—T. L. Popplebaum, no location given.

A Thanks for writing! Many of our readers would probably enjoy doing some volunteer work and getting some repair experience. The local repair shops can presumably be contacted through public libraries.

(Continued on page 76)

CALLER-ID ALARM SYSTEM

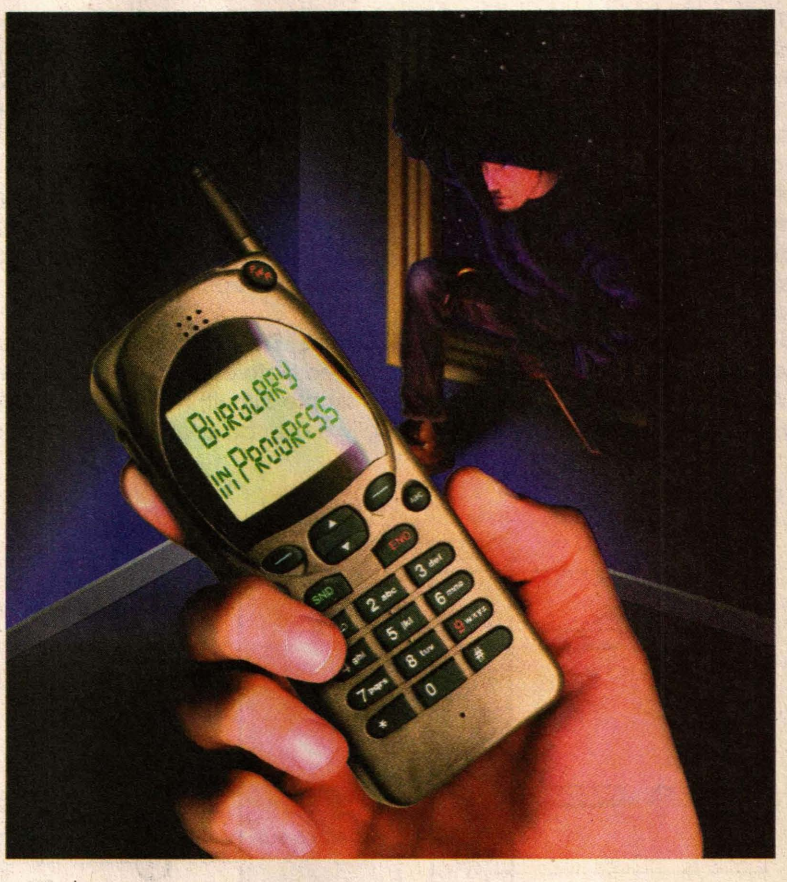
What good is an alarm system if you don't know that there's a problem? With this one, the alert is only a phone call away!

DENNIS HEWETT

When you decide that you need a security system for your home or business, you will find systems starting at "nothing down" to over $500 with installation. Like cellular telephones, little money is made on the hardware. Most alarm dealers want you to sign a contract for monthly monitoring and/or maintenance. After a few years, that "low-cost" system could add up to a considerable amount.

If, on the other hand, you need something simpler, the *Caller-ID Alarm System* presented here might just be the best solution. Using one IC and a solid-state relay, this alarm system has both a delayed- and an instant-trigger zone, and relies on the local telephone company's Caller ID service to let you know that the alarm has been tripped.

With a low parts count, the unit might be in the running for the world's cheapest and smallest alarm system; the circuit board is barely two inches square.

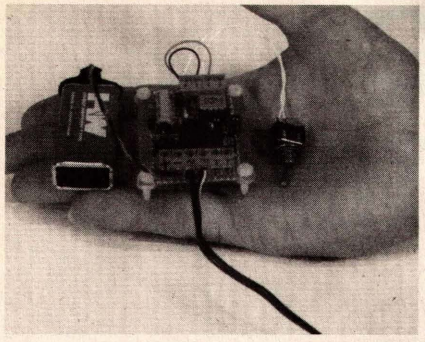


A requirement for using the Caller-ID Alarm is, of course, a subscription to the Caller ID service at all of the places that the system would call. When the alarm is triggered, it dials the telephone numbers that are programmed in the unit, waits until the caller's ID data is sent (between the first and second ring), and then hangs up. When you see the call data on your Caller ID box, you know automatically that your alarm has been activated. If the call is a toll call, you save long-distance charges by ignoring the call. You can then call the police and meet them at the alarm location or set up your own procedures for responding to the alarm.

The system continues the dialing/hanging up routine until all of the stored numbers have been dialed. After a five-minute delay, the dialing process repeats. That continues until the alarm is turned off.

How It Works. The alarm system is built around three electrical "loop" circuits called Zone 1, Zone 2, and Key. Those loops are simply wire that is grounded at one end and connected to the alarm circuit at the other end. Several switches that are closed when the protected items, such as doors and windows, are closed are wired in series with the loops. As long as all of the switches are closed, the loop is grounded. Note that although you can have more than one switch in the Key loop, we'll assume for this discussion that there is only one; that switch arms and disarms the system.

While disarmed (the Key switch



The Caller-ID Alarm System, while small enough to fit in your hand, has several interesting features packed into it.

open), the system tests the three loop inputs. If either zone is open, an LED blinks either once or twice, depending on the zone that is open, repeating after a short pause. If both zones are open, it blinks once, then twice. When both zones are closed, the LED turns on steady.

If you close the Key switch in order to turn on the alarm while either zone is open, a beeper and the LED begin pulsing as a warning that the system was not ready—some window or door might be open.

When the LED is on but not flashing, the system is ready to be activated. When the Key switch is closed, the beeper begins pulsing at one-second intervals for 30 seconds. That will give you time to leave the house and close the door without triggering the alarm. Both zones are delayed so that you can exit through any door regardless of which zone it is connected to.

After the exit time expires, the LED turns off. Since the unit has a battery in case of an AC power failure, current consumption is kept to a minimum.

Upon returning when no alarm has occurred, enter through any Zone 1 door. The beeper starts pulsing at one-second intervals for 15 seconds. If the Key switch (which should be concealed) is not turned off before the time elapses, the system starts dialing the programmed telephone number or numbers. Using a door that is connected to Zone 1 is important. If your entry door is connected to Zone 2, the system begins dialing without any warning beeps.

Circuit Description. As we mentioned before, the Caller-ID Alarm is a simple circuit; how simple it actually is can be seen in the schematic diagram, Fig. 1. The heart of the circuit is IC1, a 12C508 PIC microcontroller. Of the chip's eight pins, six can be used as input/output lines. In addition, three of those pins can have internal pull-up resistors connected—a feature that is selected by the alarm software that will be programmed into the device. Those pins are used as inputs; the other three are used as outputs.

The three input pins—4, 6, and 7—are connected to the zone loops discussed before. When all of the switches are closed, the pins are grounded. The software sees that logic level as "everything is safe." If any switch opens, the ground is removed. Normally, the result is an open input that is seen by digital inputs as an invalid state. Here is where the internal pull-up resistors come into play; they provide a valid high logic level.

Pins 2, 3, and 5 are used as outputs. Buzzer BZ1 is the audio beeper discussed earlier; the accompanying LED indicator is LED2. Resistor R2 limits the current drawn by LED2. An additional LED (LED1) in series with current-limiting resistor R1 passes the signal from pin 3 to the input of RY1. That

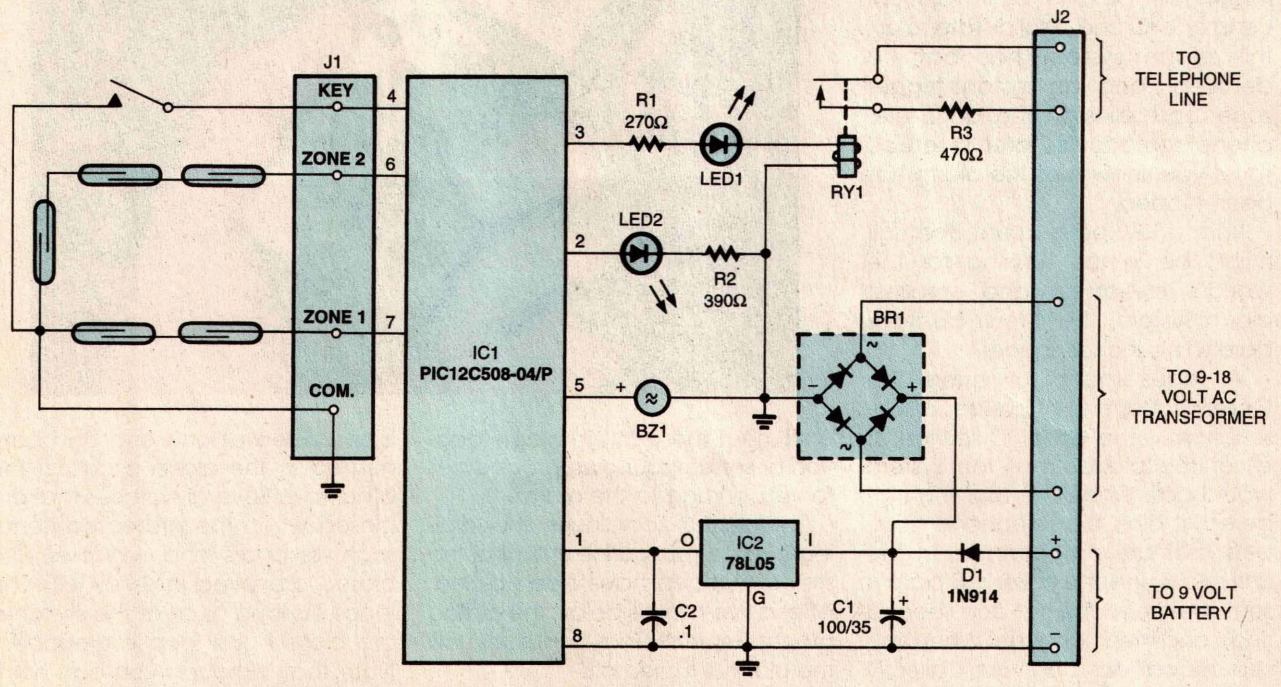


Fig. 1. The Caller-ID Alarm is based on an 8-pin PIC microcontroller. If a switch on either zone is opened, the unit places a telephone call; RY1 and R3 mimic a rotary-dial telephone. After the second ring, the system hangs up. That amount of time makes sure that the telephone company's Caller ID information is transmitted to the called number. A battery keeps the system active in case of a power failure—the system only draws 3.5 mA activated.

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relay is connected across the telephone lines, and is used for dialing.

Note that pulse dialing is used; touch-tone dialing would complicate the circuit. Here, the only addition needed is R3 to keep from shorting the telephone line out completely. When dialing, RY1 is pulsed at a rate of 10 times per second to simulate a rotary telephone. Rotary dialing works even if you pay for tone service.

A 9–18-volt AC wall-mounted transformer provides power for the circuit. The AC power is rectified by BR1, smoothed by C1, and regulated by IC2. In addition, a 9-volt battery, protected by D1, is used to keep the Caller-ID Alarm on guard if power is lost. It is important that the DC voltage level at the input of IC2 be at least 12 volts so that D1 is biased off to preserve the battery. With the system activated, the total current draw is about 3.5 mA. With all six pins on IC1 used as input/output, there are no pins left for the microcontroller's clock. In this case, the 12C508 has an internal 4-MHz RC (resistor/capacitor style) oscillator; that circuit is used as the clock source.

Construction. The Caller-ID Alarm System can be built on a piece of perfboard using standard construction techniques. A printed-circuit board can also be used; a foil pattern has been included here if you want to etch your own (see Fig. 2). Alternatively, an etched board may be purchased from the source given in the Parts List. If you use either of those sources for a PC board, use the parts-placement diagram shown in Fig. 3 for component location.

Before building the board, you should program IC1. Source code is available on the Gernsback FTP site at *ftp.gernsback.com/pub/pop/caller-id_alarm.zip*. Note that you will have to add an important piece of information to the software: the telephone number (or numbers) that the Caller-ID Alarm will be calling. While you are adding that information, you can also change a few other parameters such as the time delays for arming (30-second default), disarming (15-second default), and dialing delay (five-minute default). Those modifications are beyond the scope of this article; the source code, however, is well documented. If you do not understand how to make the changes, you should ask someone who is familiar with microcontroller programming.

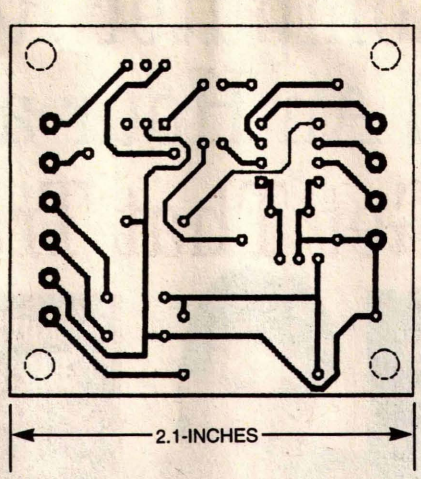


Fig. 2. Here's the foil pattern for the Caller-ID Alarm.

The PIC 12C508 microcontroller is available in two basic versions: erasable and one-time programmable (OTP). While the OTP version is much less expensive, it can (as the name implies) be programmed only once. If you need to change the phone number or make other modifications to the program, your only choice is to throw out the old chip and start with a fresh one.

The erasable version has an advantage in that respect. Simply expose the quartz window on the top of the chip to ultraviolet light of the right wavelength and intensity and the program will be erased; the chip can now be re-programmed. An ultraviolet chip eraser can be expensive unless you have access to one. Also keep in mind that you should cover the window before programming the chip. Exposure to direct sunlight will erase the chip in about two weeks; fluorescent lights will take about three years. However, a single bit can be erased in a matter of seconds, making the system unusable.

If you do not have access to a programmer, a custom-programmed chip with your telephone numbers and other preferences is available from the source given in the Parts List.

Begin by installing J1, J2, and the power-supply components (IC2, BR1, D1, C1, and C2). Connect the power transformer to the appropriate terminals of J2; do not connect the battery. Check for 5 volts at the

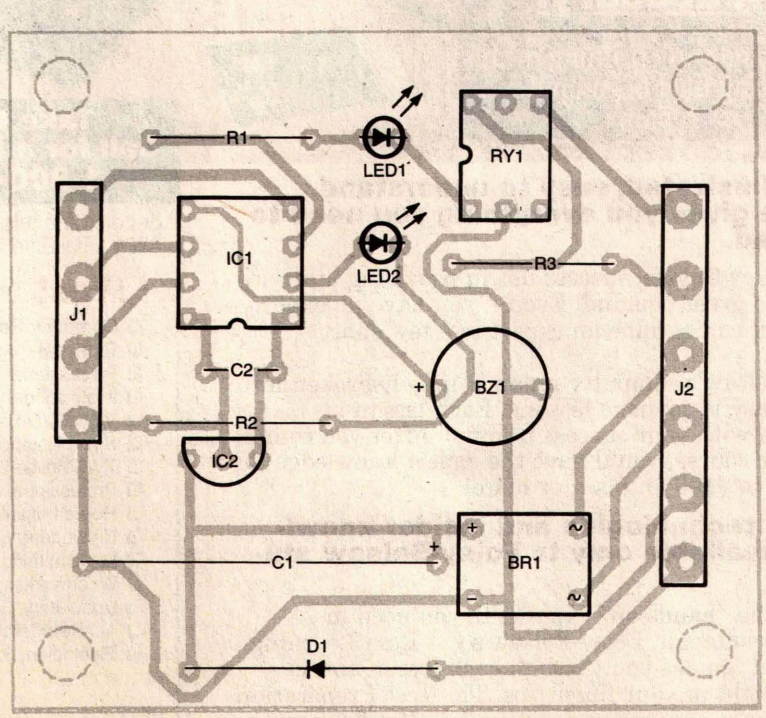


Fig. 3. Use this parts-placement diagram when building the Caller-ID Alarm from the supplied foil pattern or on a purchased PC board. The circuit is small and simple enough to fit on a single-sided PC board that only measures about 2 inches square without any jumpers.

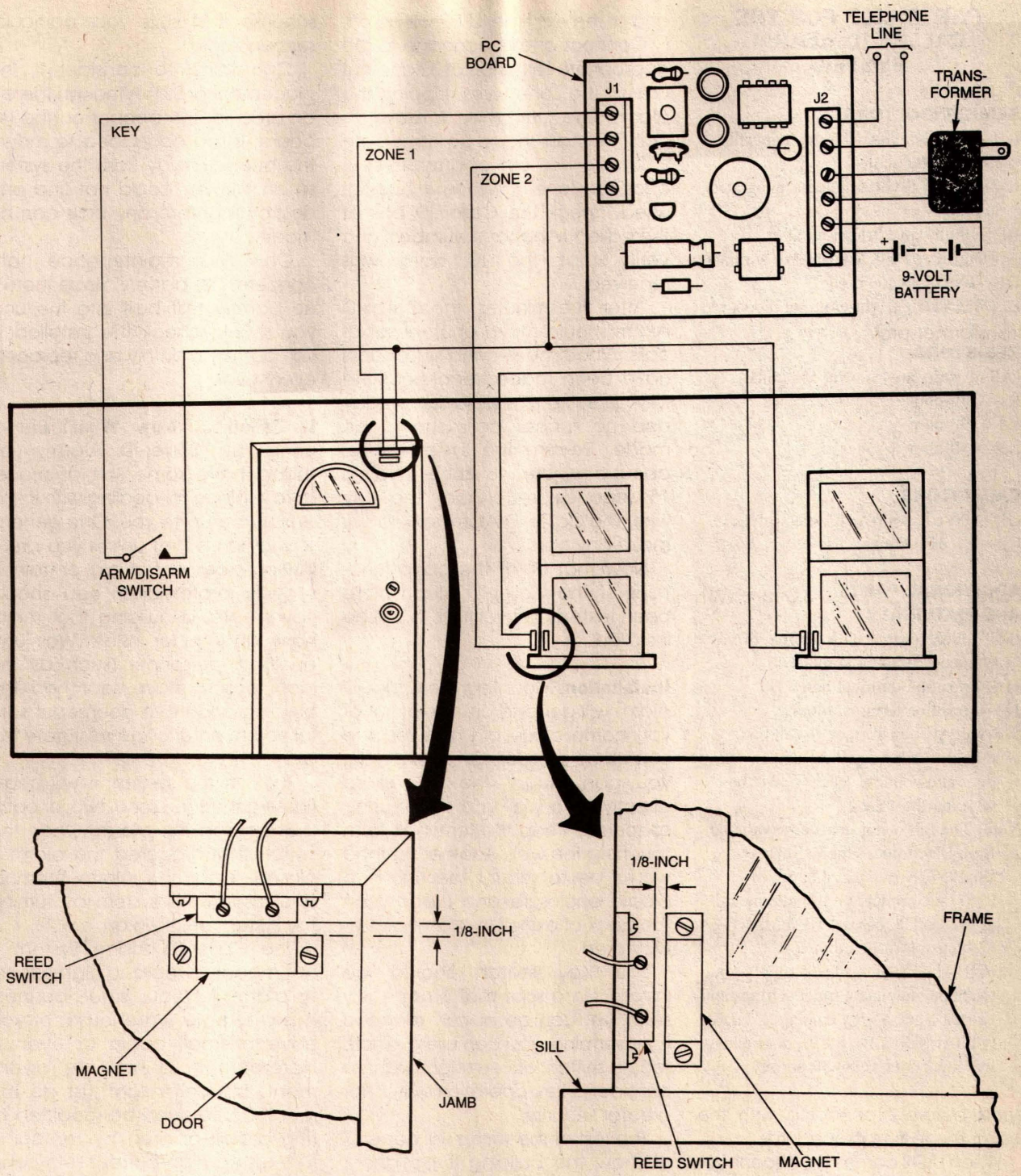


Fig. 4. Although your situation will no doubt be different, this sample shows the basics of wiring a door or window for alarm sensing. You should only wire the entry door to Zone 1 to give yourself time to deactivate the system when you enter the protected area. Windows are good candidates for Zone 2, where the alarm will be instantaneous.

output of IC2. The voltage at the battery terminal of J2 should be zero volts. Any voltage that appears there means that D1 is defective or installed backwards if the measurement is close to the transformer voltage.

Disconnect the transformer and install the rest of the components. Use a socket for IC1. Once all of the parts have been installed, double-check your work before testing the unit.

Testing. Insert three 3-inch wires in the COM terminal of J1. Connect one wire to Zone 1 and another to Zone 2. Do not connect any wires to the KEY terminal. Power up the system; LED2 should light. If it does not, remove power and check for errors such as solder shorts, mis-wirings, or polarized components that are installed backwards. Correct any

PARTS LIST FOR THE CALLER-ID ALARM SYSTEM

SEMICONDUCTORS

IC1—PIC12C508-04/P microcontroller, integrated circuit
IC2—78L05 5-volt regulator, integrated circuit
BR1—Full-wave bridge rectifier (Digi-Key DF02MGI-ND or similar)
D1—1N914 silicon diode
LED1, LED2—Light-emitting diode, red

RESISTORS

(All resistors are 1/4-watt, 5% units.)
R1—270-ohm
R2—390-ohm
R3—470-ohm

CAPACITORS

C1—100-µF, 35-WVDC, electrolytic
C2—0.1-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

BZ1—Piezo beeper with internal drive (Jameco 76064 or similar)
J1—4-position terminal block
J2—6-position terminal block
9–8-volt AC transformer, 9-volt battery clip, 9-volt battery, wire key switch, door and window security switches, wire, hardware, etc.

Note: The following items are available from Electronics Hobby Shop, P.O. Box 957, Frontenac, KS, 66763-0957: A complete kit of parts including IC1 and PC board (CIDALM2.KIT), $39; custom-programmed IC1 (CIDALM2.PIC—please supply your telephone numbers, timer settings and beeper type), $5.50; etched PC board (CIDALM2.PCB), $5.50; door and window contacts, $4.50 per set.

errors before proceeding with the rest of the testing procedures.

When LED2 comes on, disconnect the wire for Zone 1. The LED should start blinking in a one-flash-and-pause pattern. Reconnect the Zone 1 wire and disconnect Zone 2. The flashing pattern should be two and a pause. With both zones disconnected, the pattern should alternate between a single flash and two flashes between the pauses.

Connect both zone wires followed by the Key wire. The system will start beeping once per second as an exit time countdown. At the end of the exit time; LED2 will go off.

Connect a telephone line to the appropriate terminals of J2 and cut one of the Zone wires, tripping the alarm. The unit should make its calls. The calls should be immediate if Zone 2 was cut or after 15 seconds for Zone 1. When it has finished, check the Caller ID box at the called telephone numbers and verify that the ID data was received.

After five minutes, the Caller-ID Alarm should make another set of calls. Once the second set of calls have been made, reconnect the Key wire; LED2 should be steady and no further calls should be made. Re-arm the system. After about a minute, cut Zone 1. Within 15 seconds, reconnect the Key wire. The Caller-ID Alarm should *not* make any calls.

Now that all of the basic functions of the Caller-ID Alarm have been tested and verified, it can be installed.

Installation. Mounting the Caller-ID Alarm will depend on the layout of your home, office, or whatever area you will be protecting. For example, you can mount the PC board directly on a wall in a closet using spacers to keep the terminals from touching the wall. Another method would be to mount the unit in a plastic enclosure and place it on the back of a shelf in an out-of-the-way area.

The Key switch should be installed in a spot that is not easily seen, yet can be quickly reached for disarming. You can use a simple toggle switch, or you might want to consider a key-operated switch for greater security.

The rest of the wiring will depend on how the building is designed. Figure 4 shows a sample installation. The switches shown are standard magnetic reed switches that should be closed when the door or window that they are mounted to is closed. Be sure to protect the lower half of a window, unless you have heard of intruders that climb into a room through the *upper* portion of a window!

Again, keep in mind that every building will be different, and it will be up to you to select the wiring scheme that suits your particular surroundings.

One thing to consider is the placement of BZ1. Although there is an area for the beeper on the PC board, it is a good idea to mount the beeper away from the system so an intruder could not find and destroy it before any calls can be made.

One final maintenance note concerns the battery. Since there is no battery test built into the unit, you should check the installed 9-volt battery monthly and replace it every year.

It Called ... Now What? Before using the Caller-ID Alarm, you should have some sort of procedure in place for dealing with it; the details are up to you. One general suggestion is that unless you are a law-enforcement official or trained security professional, you should never enter a building that might have an intruder inside. Wait until qualified personnel (such as the local police) have searched the building and have deemed it safe for you to enter and investigate the alarm.

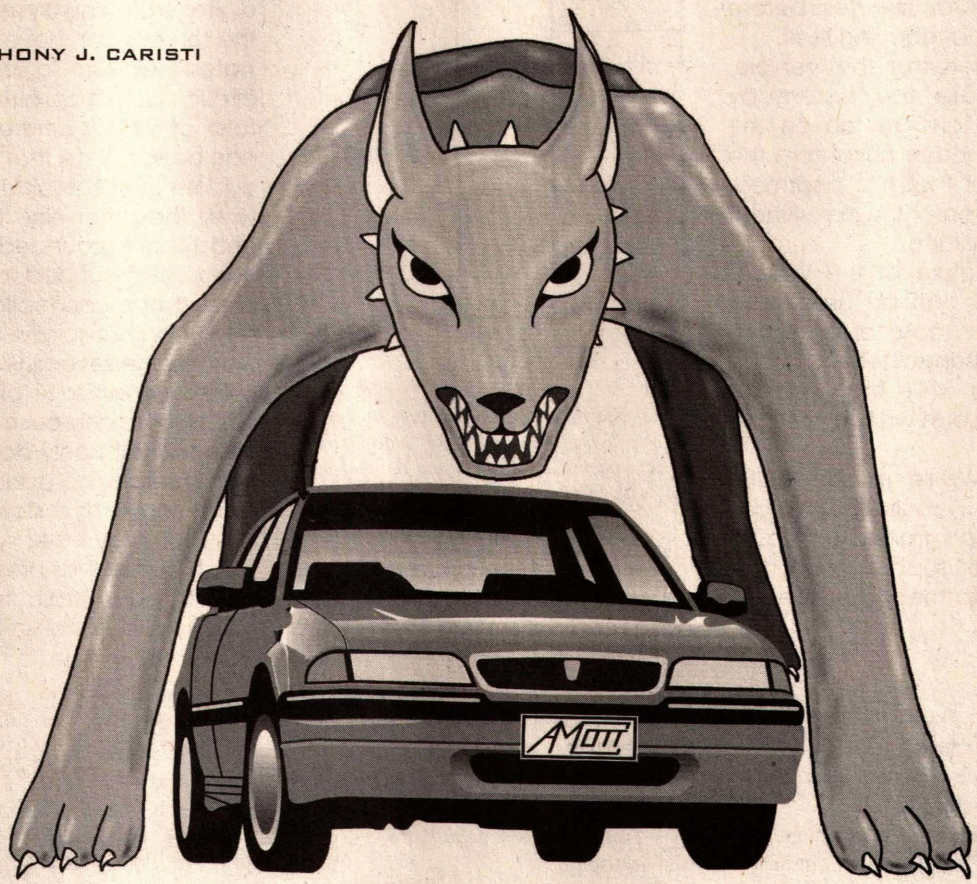
Turn off the system; it will begin flashing the zone (one, two, or both) that caused the alarm. Once the switch that triggered the alarm is closed, clear the alarm memory and disarm the system by turning the system off, then on.

The Caller-ID Alarm System is not meant to replace high-security alarms. If your small business has a remote warehouse, or you have a small cabin or even a storeroom in a high-rise apartment, this unit might just do the job. It could even be modified to ring a bell or siren by replacing RY1 with a high-current relay and modify the dialing portion of the program. It could be reduced to one zone with dialing *and* an additional relay for a bell or siren. The possibilities are only limited by your imagination.

The author would like to acknowledge George Washington (yes, that is his real name), an engineer with the city of Pittsburg, Kansas, who came up with the idea of using Caller ID for the alarm-reporting method. Ω

THE WATCHDOG

ANTHONY J. CARISTI



Protect your vehicle against theft with this easy-to-install, remote-controlled security system.

If you own a late-model vehicle, you know how much of your hard-earned money is invested in it. You want to do everything possible to prevent theft; anyone who has had their car stolen knows that all of the theft insurance in the world will not fill that feeling of helplessness and loss.

One of the obvious first steps to take in that situation is to install some sort of alarm system. While there is no way to prevent the professional thief from taking your property, a loud siren will scare off the average joyrider or less-confident larcenist. When it comes down to it, no one likes being the center of attention when breaking the law.

One type of alarm system that will protect your vehicle is the *Watchdog* system presented here. Installation in any vehicle is extremely easy: a two-wire hookup to the vehicle's battery. Although it uses state-of-the-art UHF wireless technology, no radio expertise is needed; readily available low-cost radio-frequency modules make it easy to build. The 418-MHz circuits need no RF-alignment procedures. The entire RF circuitry of both the transmitter and the receiver is contained on low-cost hybrid modules designed to meet all requirements of Part 15 of the FCC Rules and Regulations that govern unlicensed transmitters.

You might never need the protection that the Watchdog provides, but like its namesake, it's a nice feeling to know it's there.

How It Works. The Watchdog is composed of two parts: a digitally encoded portable miniature UHF transmitter "fob" that you keep when you exit the vehicle, and a companion receiver that is permanently installed under the hood of the vehicle. As we mentioned before, two wires connected to the battery of the vehicle are all that is required to install the system. The

receiver draws just a couple of milliamps of current, so it can never run the battery down.

When you leave your car, simply press the "ON" button on the Watchdog's transmitter. The siren then chirps, verifying that the system is activated. Once armed, the system senses the opening of a door of the vehicle, sounding a siren for several minutes before shutting off and rearming itself.

Before reentering the vehicle, you deactivate the system by pressing the "OFF" button on the transmitter. Another chirp from the siren indicates that it is disarmed; you can now enter the car without sounding the alarm.

Another feature of the Watchdog is that it can be used as a panic alarm in case of an emergency. If the transmitter's "ON" button is pressed while the engine is running, the alarm will sound.

Transmitter. While its schematic diagram (Fig. 1) might look simple, the Watchdog's transmitter has a fair amount of sophistication built into it thanks to the use of specialized ICs.

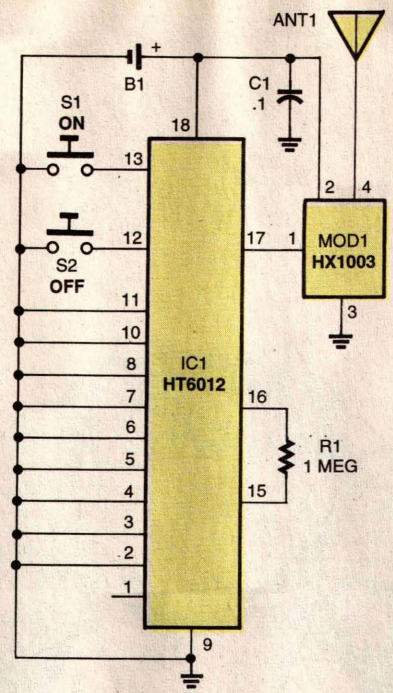


Fig. 1. The Watchdog's transmitter uses a single-chip hybrid module for RF transmissions; no adjustments are needed, and the unit complies with FCC regulations.

The heart of the circuit is IC1, the encoder half of a digital encoding/decoding system developed by Holtek Microcircuits specifically for wireless applications such as the Watchdog. An encoded "key" is needed to prevent the system from being compromised by interference, other transmitters operating on the same frequency, or unauthorized signals being aimed at the receiver. That key is generated by IC1. Although the Watchdog uses a digital-encoding system, each of the ten bits can have one of *three* states: logic zero, logic one, or open circuit. With that arrangement, a total of 59,1049 different addresses can be set. Note that in Fig. 1, one address selector (pin 1) is left open, while the other nine (pins 2–8, 10, and 11) are grounded. Any combination of grounded, open, or supply-voltage connections may be selected; especially useful if you want to use several Watchdogs.

Pressing either S1 or S2 activates IC1; an encoded pulse train appears at pin 17. Not only does that pulse train contain the address setting, it also contains the status of S1 and S2. That way, the system knows which button was pressed.

That pulse train is passed to MOD1, a UHF transmitter module.

PARTS LIST FOR THE WATCHDOG

SEMICONDUCTORS

IC1—HT6012 remote-control encoder, integrated circuit
IC2—3.3-volt regulator, integrated circuit (Digi-Key 158-1088-ND or similar)
IC3—OPA2340PA op-amp, integrated circuit
IC4, IC6—LMC555CN CMOS timer, integrated circuit
IC5—HT6032 remote-control decoder, integrated circuit
MOD1—HX1003 418-MHz hybrid transmitter, integrated circuit
MOD2—RX1300 418-MHz hybrid receiver, integrated circuit
Q1—IRL540N N-channel MOSFET transistor
Q2, Q3—ZVN3310A N-channel MOSFET transistor
D1, D5—1N4004 1-amp, 400-PIV silicon rectifier diode
D2–D4, D6—1N4148 general-purpose silicon diode
D7—1N5817 Schottky diode

RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)
R1—1-megohm, 1% metal-film
R2—100-ohm
R3, R5—47,000-ohm
R4, R6–R8, R13, R15—470,000-ohm
R9, R14—1-megohm
R10—220,000-ohm
R11—10-ohm
R12—90,900-ohm, 1% metal-film

CAPACITORS

C1—0.1-µF, ceramic-disc
C2—100-µF, 25-WVDC, electrolytic
C3, C4, C6, C11—1-µF, 25-WVDC, electrolytic
C5, C7—0.001-µF, ceramic-disc
C8, C12, C13, C15—0.1-µF, ceramic-disc
C9—220-µF, 25-WVDC, electrolytic
C10, C14—10-µF, 25-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

ANT1—Insulated wire, 6fi inches
ANT2—Insulated wire, 6 1/2 or 13 inches (see text)
B1—3-volt Lithium coin-cell battery, BR1225 or similar
BZ1—12-volt siren (Mouser 539-PS723 or similar—see text)
S1, S2—Single-pole, single-throw momentary-contact pushbutton switch (Mouser 101-0461 or similar)
Transmitter case (Mouser 616-71971 or similar), receiver case, wire, hardware, etc.

Note: MOD1 and MOD2 may be purchased from Spectrum Microwave Products, Norcross, GA; Tel: 888-977-3267.

Note: The following items are available from: A. Caristi, 69 White Pond Road, Waldwick, NJ 07463: Set of two etched and drilled PC boards, $24.75; IC1, $6.75; IC2, $3.00; IC3, $6.75; IC4, $3.00; IC5, $6.75; IC6 $3.00. Please add $5.00 postage/handling. NJ residents must add appropriate sales tax.

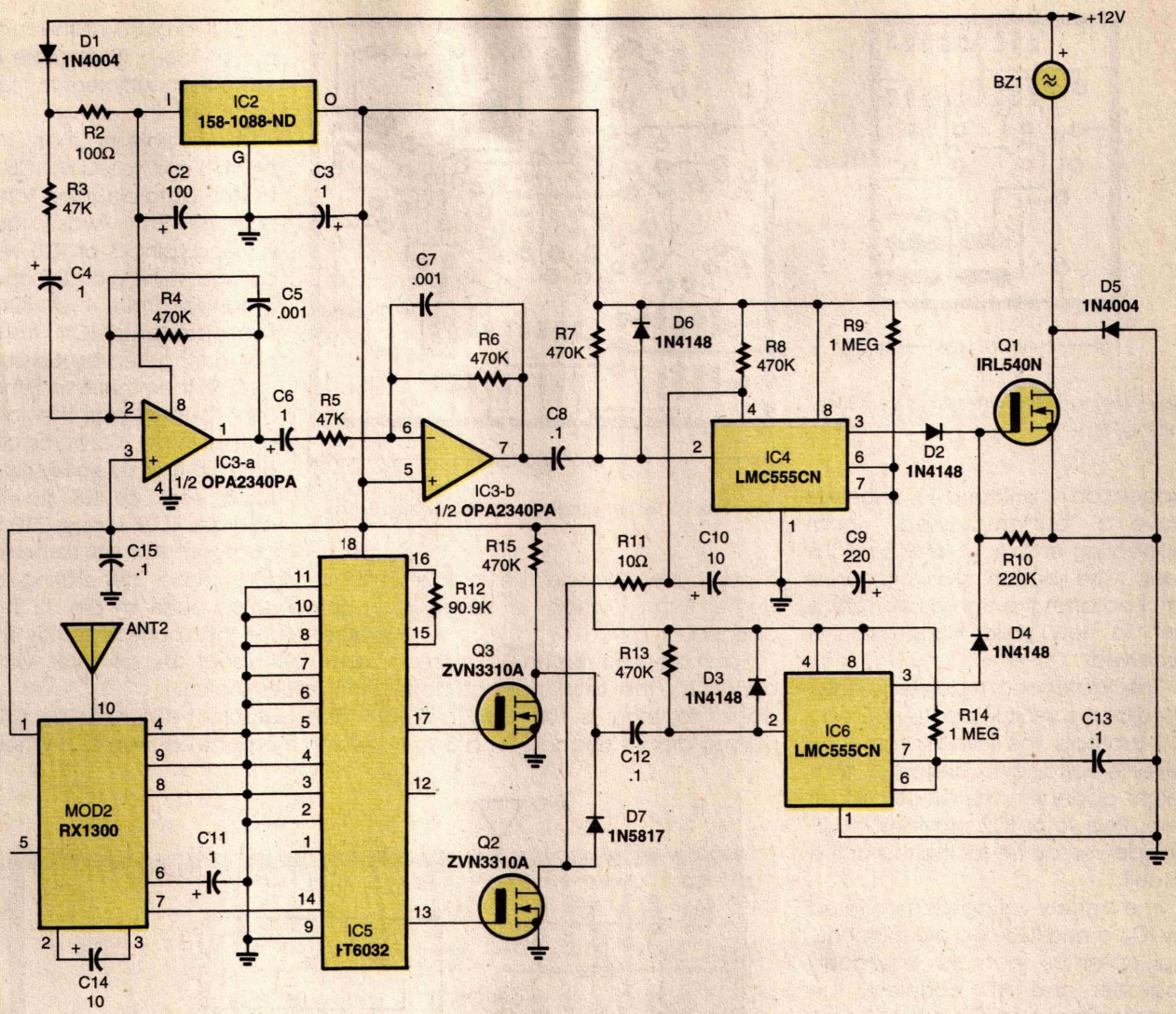


Fig. 2. The Watchdog's receiver senses if a door has been opened by watching for any voltage sag on the battery.

Within that module is a surface-acoustic-wave (SAW) stabilized UHF oscillator. The internal SAW filter is set for a frequency of 418 MHz. A second SAW filter removes any undesirable harmonics from the carrier wave. When the pulse train from IC1 is sensed on pin 1 of MOD1, a series of RF pulses appear on pin 4. That type of modulation is called *amplitude-shift-keying* modulation. The RF signals are transmitted by ANT1, a short antenna wire about six inches long. The hybrid module is capable of delivering about 1 mW peak power at 0 dBm into a 50-ohm load, one of the features that makes the system comply with FCC regulations.

Power for the circuit is provided by a 3-volt lithium coin cell. Current drain during standby periods is only a microamp or two, so no off/on switch is needed.

Receiver. The companion receiver for the Watchdog is shown in Fig. 2. RF signals from the transmitter are picked up by ANT2 and demodulated by MOD2. That receiver module represents a new technology called *Amplified Sequenced Hybrid* (ASH), which was developed by RF Monolithics. The ASH receiver contains a SAW bandpass filter, two RF amplifiers, a SAW delay line, an RF detector, and digital-control circuitry. It is fixed-tuned by the filter circuits so that it operates at only the desired receiving frequency, needing just 3 volts of power. The novel approach to the internal workings of the module hinge around the two RF amplifiers; the output of the first is connected to the input of the second through the delay line. The digital control turns the amplifiers on and off such that neither is on at the same time. That technique lets the hybrid run at very high gain levels without the possibility of oscillation. The demodulated pulse train is output on pin 7.

The ten address lines of decoder chip IC5 are wired the same as the encoder, so that the receiver responds only to its companion transmitter. Again, note that Fig. 2 is drawn with the same code as the transmitter (Fig. 1). As long as two successive pulse trains contain the correct address, the "valid output" terminal (pin 17) goes high; it remains in that state as long as the transmitter is operating.

The status bits of S1 and S2

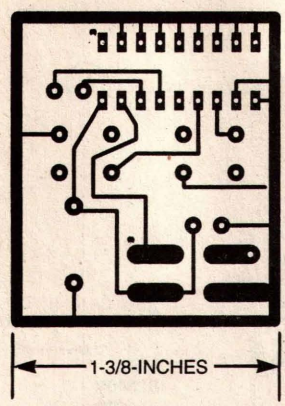


Fig. 3. Here's the foil pattern for the Watchdog's transmitter.

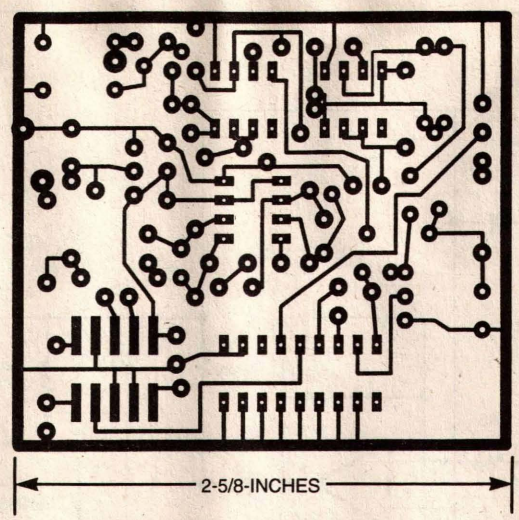


Fig. 5. Here's the foil pattern for the Watchdog's receiver.

appear on pins 12 and 13. Since we have a "button-pressed" signal appearing on pin 17, only pin 13 is used. The button status remains latched after the transmission stops until a new valid transmission is received.

The Watchdog receiver is powered by the vehicle's battery. Diode D1 protects the circuit from any reverse-voltage transients that might appear in the electrical system. Regulator IC2 provides a 3.3-volt power source for the rest of the circuit.

The battery voltage is monitored by IC3-a and IC3-b, a pair of identical op-amps that are cascaded together and AC coupled. The inverting input of IC3-a is AC coupled to the vehicle's battery so that it can detect a sudden sag in battery voltage that would be caused by the current draw of the vehicle's dome lamp when a door is opened.

Each op-amp has an AC gain of about 10; the total gain of both stages together is 100. Only a 30-millivolt drop is needed for a 3-volt negative pulse at the output of IC3-b. That pulse is more than sufficient to trigger IC4.

The enable input of IC4, pin 4, is controlled by IC5's button-data pin. If the "off" button, S1, was last pressed, pin 13 of IC5 will by high, turning on Q2 and grounding pin 4 of IC4. That prevents IC4 from being triggered by IC3-b.

If, on the other hand, the "on" button was the last one pressed, Q2 turns off and pin 4 of U4 slowly rises to 3 volts as R8 slowly charges C10. Once C10 is charged, IC4 will respond to a trigger pulse, generating a positive-going pulse at pin 3. The duration of that pulse is set by R9 and C9; about four minutes with the values shown.

The output of IC4 turns on Q1, which then powers siren BZ1. When

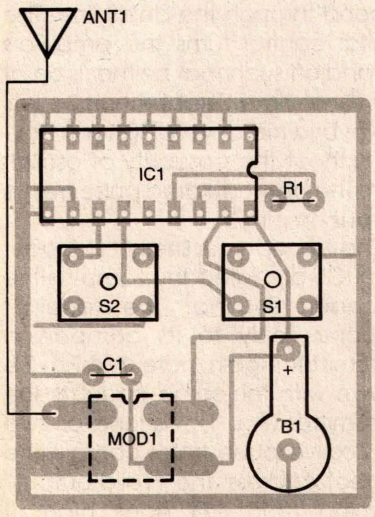


Fig. 4. The transmitter, thanks to its low parts count, is small and compact. Note that MOD1 is installed on the solder side of the board.

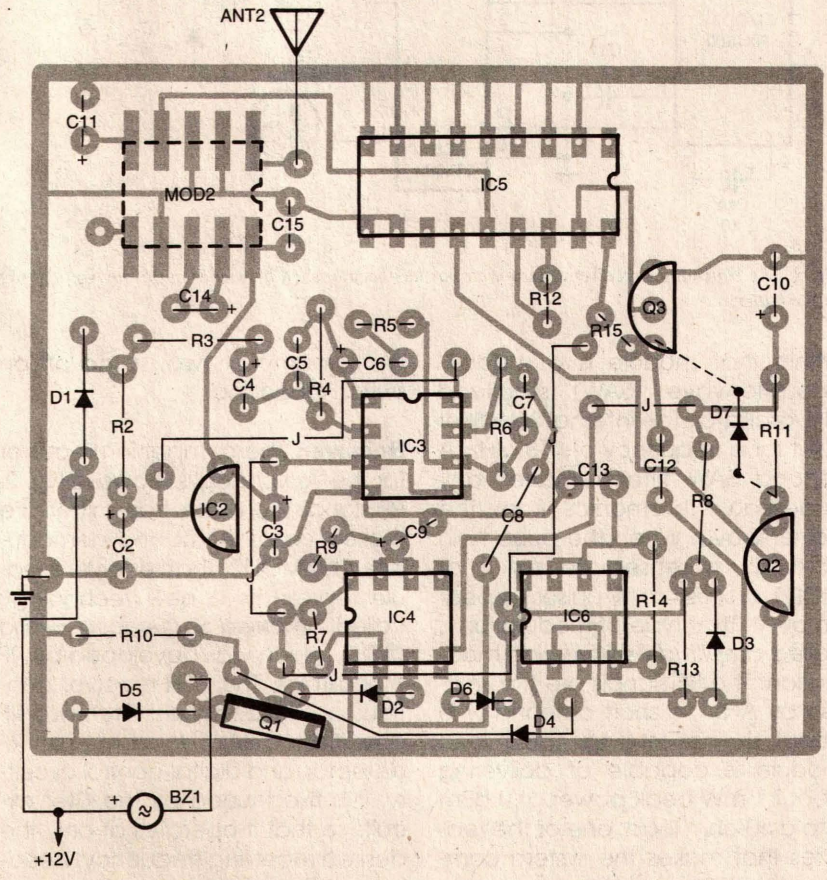
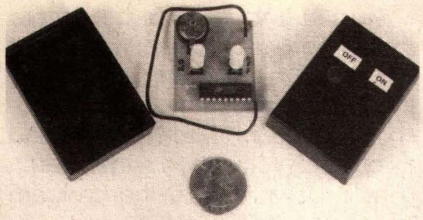


Fig. 6. The receiver, while more complex than the transmitter, also uses a single-sided board; several jumpers are needed. Like its companion on the transmitter, MOD2 is installed on the solder side of the board. Also note how D7 is installed. Likewise, the leads for Q1 will need to be formed to match the hole pattern (see text).



The completed transmitter board is ready for installation in its case. Note how ANT1 is wrapped around the assembly.

IC4 times out, it resets, silencing BZ1; the circuit is ready for another trigger pulse from IC3.

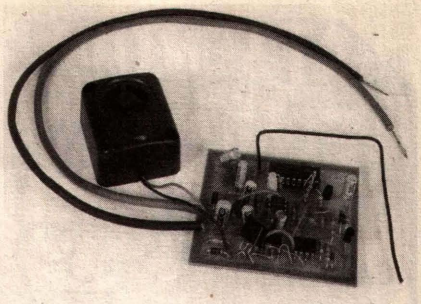
As we mentioned before, pin 17 of IC5 goes high whenever one of the transmitter buttons is pressed. That turns on Q3, which is capacitively coupled to the trigger of IC6. The output pulse of IC6 is 0.1 second long. Through D4, IC6 "chirps" the siren, verifying that both the transmitter and receiver are working.

Transmitter Construction. The transmitter is best constructed on a printed-circuit board. Perfboard is not practical in this case because of the surface-mount components involved. If you use the supplied single-sided foil pattern shown in Fig. 3, the parts-placement diagram in Fig. 4 should be followed. If you do not wish to etch your own board, one is available from the source given in the Parts List.

When assembling the board, do not install MOD1 or ANT1; that will be done later. Also, do not insert the battery into its holder until you are told to do so. Be sure to install IC1 the right way around; a reversed part will be destroyed the moment power is applied. The battery holder must also be installed correctly. Note that if you do install it the wrong way, the holes for S1 will be blocked. You may use a socket for IC1 if you wish, although it can be soldered directly to the board.

Locate and drill two holes in the case for the buttons that are mounted to S1 and S2. The completed board and case can be seen in the accompanying photo.

When you are finished with the board, check it over carefully for bad solder connections, and open or short circuits. Any solder joint that is not smooth and shiny is suspect and should be redone by removing the old solder, cleaning the joint, and resoldering. It is much easier to correct problems now rather than later on should you discover that the transmitter is not working.



In this photo of the completed receiver unit, you can see how Q1 is installed.

Once you are satisfied with your work, set the transmitter board and case aside.

Receiver Construction. All of the above instructions relating to building the transmitter apply equally to the receiver. Figure 5 is the foil pattern for the single-sided PC board;

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the parts-placement diagram is shown in Fig. 6.

As with the transmitter, MOD2 and ANT2 are not to be installed at this time. Since the receiver will be installed in the car, it will be subject to much more vibration and temperature extremes than the transmitter. For that reason, it is recommended that the integrated circuits be soldered directly to the board without the use of sockets. Note that D2 is mounted by drilling appropriate holes in the board, inserting the component into those holes, and folding the leads over in the directions shown. Be careful not to cause a short to any of the PC-board traces in the area. Solder the diode leads to the connections shown in Fig. 6.

While it might appear that Q1 is inserted straight into the board, it is not. The gate lead (normally on the left when reading the MOSFET's markings) is bent so that it uses the center hole next to D2 and D4. The center lead (drain) connects to D5. A heatsink is not needed for transistor Q1.

Several jumper wires are needed by the receiver. Use insulated wire for the connections to prevent any accidental shorts as the jumpers pass over the various component leads.

Once you've inspected your workmanship for any mistakes, the Watchdog is ready for testing.

Siren Selection. You will need to temporarily attach the siren (BZ1) to the receiver for testing. While the unit given in the Parts List is one possible siren that can be used with the Watchdog, others can be used as long as they do not draw more than two amps. That current level can safely be handled by Q1 without the need of a heatsink.

The suggested unit in the Parts List is rated at 150 milliamps.

Testing. To test the Watchdog, make three temporary connections between IC1 on the transmitter and IC5 on the receiver. Connect pin 18 to pin 18 and pin 9 to pin 9. That way, the regulated 3.3-volt power supply on the receiver will power the transmitter as well. In addition, make a connection from pin 17 of IC1 to pin 14 of IC5. That will feed the encoded output of the transmitter directly to the input of IC5.

Connect the receiver to a well-regulated 12-volt DC power source. One ripple-free source is a 6- or 12-volt battery. Whatever power supply that you use should have enough current capacity to drive the siren that you are using; a common 9-volt transistor-radio battery is not suitable.

With power applied, measure the voltage at the positive side of C3. You should be reading about 3.3 volts. If not, disconnect the power and troubleshoot the circuit to locate and repair the fault. Possible areas to check include the orientation of D1, IC2, C2, and C3. Measure the resistance to ground at the positive end of C2 and C3 to be sure that there is no short circuit to ground; you should read in the thousands of ohms. You might need to replace IC2. In any case, do not resume testing until IC2 is properly outputting a regulated 3.3 volts to the circuit.

Press S1 and S2 separately; there should be a short beep from BZ1. If BZ1 doesn't work, check pin 17 of IC5 with a voltmeter or oscilloscope; it should switch from ground to about 3 volts when either switch is held down. If not, the problem could be with IC1 or IC5.

If IC5 is working, check D2–D4, Q1–Q3, and IC6. Make sure that those parts are properly inserted into the board. You can manually trigger IC6 by momentarily shorting pin 2 to ground; there should be a 0.1-second pulse at pin 3. That pulse should be traceable through D4 and Q1 and, ultimately, BZ1. You might need to try a new transistor or IC. Don't forget to check the connections to BZ1.

The final test verifies that the alarm will sound when the 12-volt power-supply voltage sags. The best way to make that test is to connect the receiver/transmitter assembly to the battery of a vehicle with the engine off. Press S1 and then S2 to arm the system. There should be a chirp from BZ1 each time. Wait about 30 seconds and then open the door of the vehicle. The alarm should sound. It will automatically shut off after a few minutes, or pressing the "OFF" pushbutton can silence it.

If the receiver does not respond to the opening of the door, check around IC3 and IC4. Like IC6, you can manually trigger IC4 in the same way. Check pin 13 of IC5 to verify that it goes to zero volts when the system is on. Also look into Q2, Q3, and D2.

If the Watchdog passes those tests, it is ready for final assembly and installation.

Transmitter Final Assembly. Disconnect power from the circuit and remove the temporary wires that connect the transmitter and receiver together. Disconnect BZ1.

Install MOD1 on the solder side of the transmitter board. Start by tinning both the pins of MOD1 and the pads on the PC board. Doing so will help achieve a solid solder connection. When tinning MOD1, keep the application of heat to an absolute minimum.

Place MOD1 on the board, carefully lining up the pins with the

pads. Double check the orientation before proceeding. Solder MOD1 in place using only enough heat to attain a good connection. Do only one terminal first and examine the position of the remaining three terminals. If everything lines up, solder the rest in place.

Use a 6fi-inch piece of insulated wire for ANT1. Wrap ANT1 around the PC board as shown in the photo. Insert B1 into its holder, place the board in the case, and close it up.

Receiver Final Assembly. Install MOD2 on the receiver board in the same way that MOD1 was installed on the transmitter board. A similar piece of insulated wire is used for ANT2. You can use a 6 1/2-inch length for a 1/4-wavelength antenna or double it to 13 inches for a 1/2-wave antenna; the longer length will have a greater operating range.

Since it will be installed in the engine compartment of the vehicle, it should be housed in a small plastic enclosure to keep dirt, grease, and other "underhood nasties" away from the circuitry. Holes should be drilled for the power leads, BZ1, and ANT2. The power leads should be of at least 16-gauge wire; red and black colors will help identify which wire is which. The wires for BZ1 can be 18 gauge in size.

Mount the receiver in the engine compartment of the vehicle as close as possible to the battery. Be sure to choose a location that is protected from road hazards such as rain and snow, and keep the unit away from any part of the engine that operates at a high temperature, moves, or rotates. Stretch the antenna wire so that it is reasonably straight.

Using The Watchdog. Take the transmitter with you each time you leave the vehicle. After closing and locking the doors, press the "ON" button. A short beep from BZ1 will verify that the Watchdog is armed.

If a door is opened while the Watchdog is armed, the alarm will go off. It will automatically go off after a few minutes, but may be manually turned off using the transmitter's "OFF" button.

When you return to the vehicle, press the transmitter's "OFF" before entering. The beep verifies that the system is disarmed; the vehicle may be entered without sounding the alarm.

To use the Watchdog as a panic alarm while the engine is running, simply press the transmitter's "ON" button. The alarm will go off after a short delay due to the timing function of R8 and C10.

Normal battery life for the transmitter will depend upon how many times the circuit is activated; it should be a year or more with normal use. If the transmitter seems to be losing range or becomes erratic, replace the battery. Ω

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Electronic Padlock

Electronic locks can block access to your computer terminal, prohibit ignition in your automobile, be used in a host of other applications where preventing unauthorized access to important data or use of expensive equipment is paramount.

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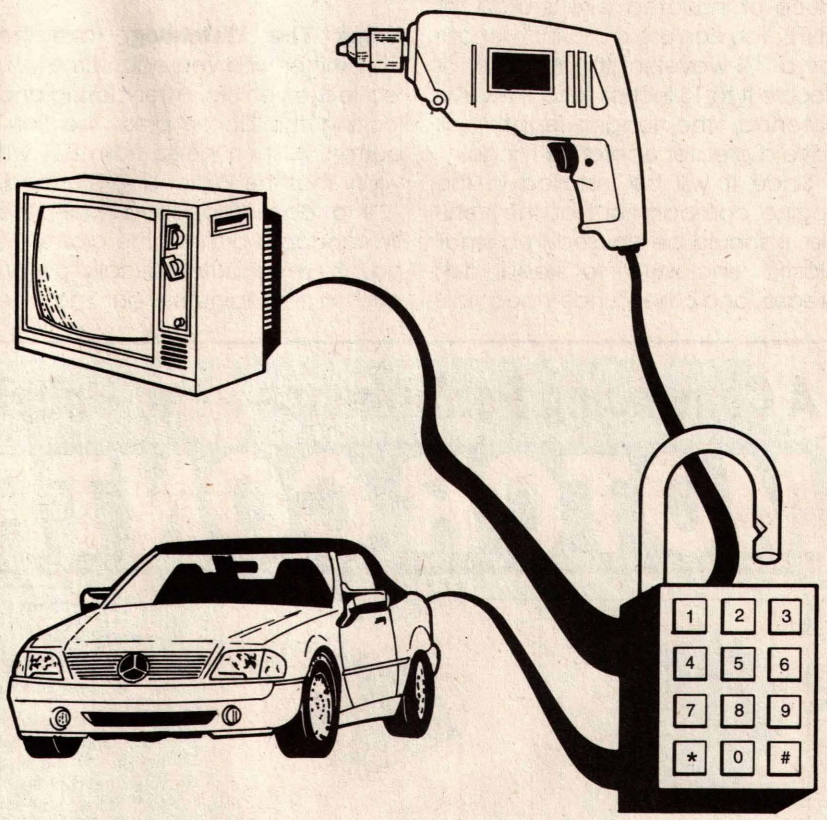

There's just no way around it. Wherever you look, electronic gadgets of all types are replacing their mechanical counterparts. For example, mechanical ignition systems in automobiles have been supplanted by solid-state electronic mechanisms. In addition, in many large corporations—where protecting company secrets and other assets is often more important than securing the products they manufacture—old-fashioned keylocks have been replaced by electronically controlled locking mechanisms. Who knows, in a decade or so, keylocks may follow the dinosaur into extinction.

The technology behind electronically controlled, keyless locks has been around for some time now, but is only now finding widespread application in the consumer marketplace—witness the proliferation of electronic door-locks and lockout mechanisms used in modern automobiles.

In this article, we'll show you how to build your own electronic lock—dubbed the *Electronic Padlock*—which can be used to secure almost all of your valuable possessions. The Electronic Padlock is an extremely useful device designed to help you control the use of your electrical and electronic equipment. Attach one to your power tools to keep your children from accidentally turning them on and causing injury. Connect one to your PC and keep unauthorized people from accessing your data. Add a solenoid and you have an electronic door lock. Use it in your car or boat as a security system. The applications are limited only by your imagination.

The hardware of the Electronic Padlock is centered around Microchip Technologies PIC16C54A microcontroller. The Padlock contains an EEPROM (electrically erasable programmable read only memory) that stores your personal 4-digit security code. Once it's programmed, only you can change the security code. Even if power to the Padlock is lost or removed, your code is remembered, and your equipment kept safe. Don't worry, if you forget your code—there is an emergency override built into the hardware.

The Padlock contains a power relay to let you switch an AC or DC load. The relay is rated for 8 amps at 250 volts AC or 5 amps at 30 volts DC. A 117-volt AC to 12-volt DC

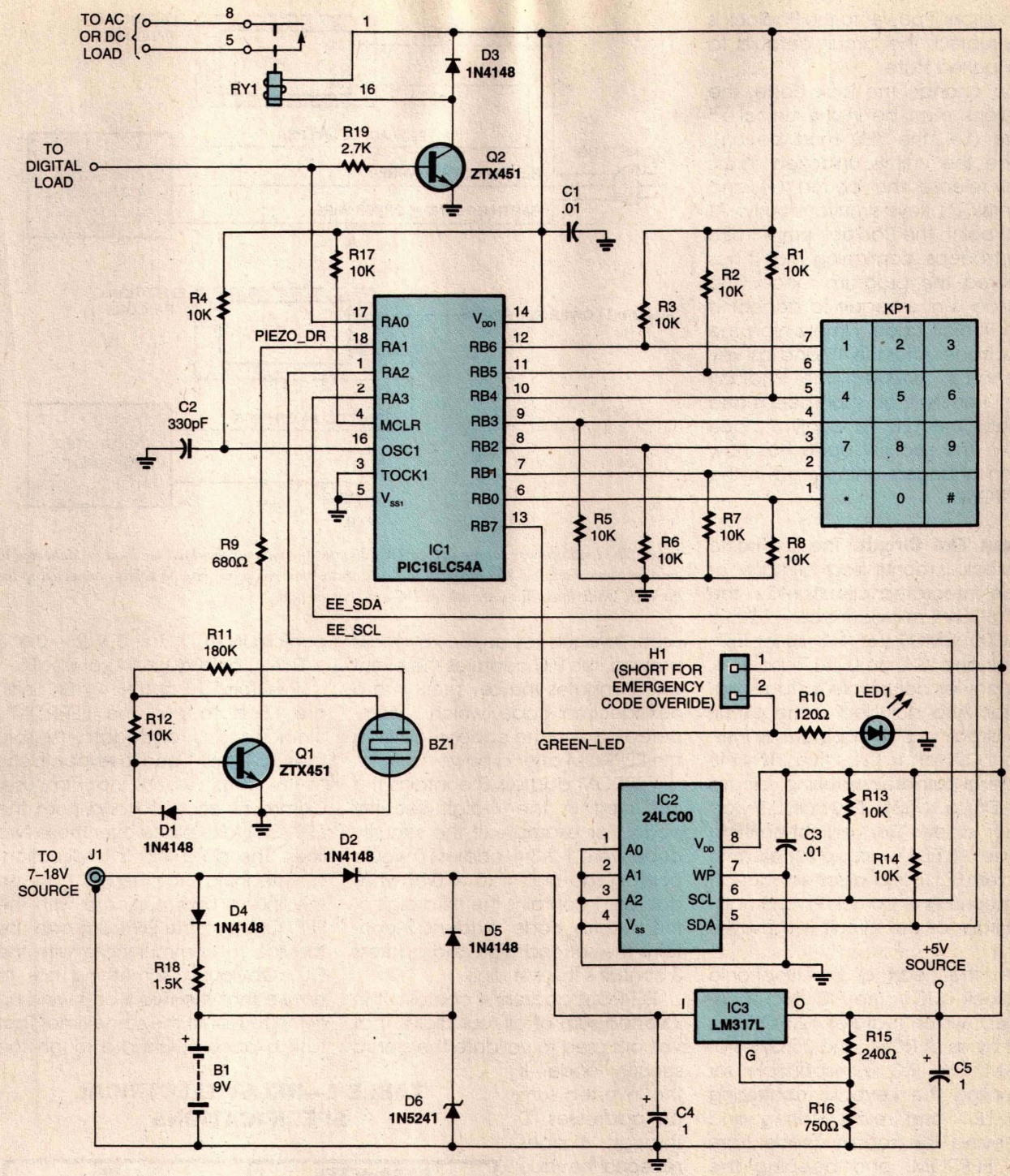

Fig. 1. At the heart of the Electronic Padlock is a PIC16C54A (IC1), a general-purpose microcontroller that features 12 I/O lines, 512 bytes of ROM, and 25 bytes of SRAM.

standard wall transformer (also known as a wall wart or power brick) provides power for the Padlock. The Padlock also will run from a 9-volt NiCd rechargeable or alkaline battery for many hours in case of power failure. When operating from the power brick, the NiCd battery is automatically charged.

Padlock Operation. To lock the Padlock, simply enter your 4-digit security code via the 12-key keypad, which causes the Padlock to emit a short beep for each key pressed. The 4-digit security code can consist of any combination of numbers from 0 through 9. Once you've entered the correct security code, the Padlock emits a 1/2-second beep, de-energizes the relay, and turns the LED off to indicate that the circuit is in the locked mode.

To unlock the Padlock, simply enter the selected 4-digit code. Once the correct security code is entered, the unit emits a 1/2-second beep, energizes the relay, and turns the LED on, indicating an unlocked

condition. If power to the Padlock is interrupted, the circuit defaults to the locked state.

To change the lock code, the Padlock must be in the unlocked state (*i.e.*, the LED must be on). Once the unit is unlocked, press and release the pound (#) and asterisk (*) keys simultaneously. At that point, the Padlock emits three short beeps, confirming that it has entered the program mode. The device is now ready to accept a new 4-digit code. Simply type the new code. After the 4th and last key has been pressed, the Padlock again emits three short beeps and flashes the LED to confirm code entry. The security code has now been changed and stored in the EEPROM.

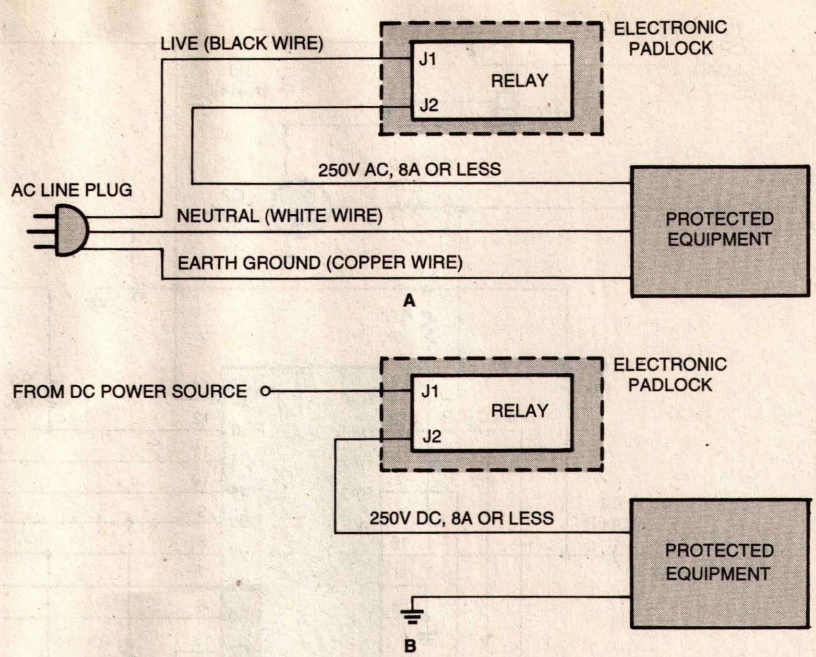

Fig. 2. The load's power source (AC or DC) dictates the manner in which the load is connected to the Electronic Padlock. The diagram in A illustrates how AC loads can be safely connected to the Padlock, while illustration B outlines DC-load connection.

About The Circuit. The Electronic Padlock is comprised primarily of three integrated circuits—IC1, the PIC16C54A microcontroller; IC2, a 24LC00 CMOS 16 × 8 serial EEPROM; and IC4, an LM317L positive, low-power, adjustable voltage regulator. Also included in the circuit are a pair of ZTX451 bipolar transistors, Q2 and Q1; five 1N4148 general-purpose switching diodes (D1–D5), a 1N5241 11.0-volt, 0.5-watt Zener diode (D6); a light-emitting diode (LED1); a piezoelectric buzzer (BZ1); and assorted support components. A complete schematic diagram of the circuit is shown in Fig. 1.

At the heart of the Electronic Padlock is IC1 (the PIC microcontroller), which features 12 I/O lines, 512 bytes of ROM, and 25 bytes of SRAM. The PIC is responsible for sampling the keypad, controlling the LED and relay, storing and retrieving the security code from the EEPROM, and beeping the piezoelectric buzzer.

Resistor R4 (a 10,000-ohm unit) and capacitor C2 (330 pF) combine to generate the clock signal required for the operation of the PIC (which is configured to operate in RC mode). With the values chosen for R4 and C2, the clock frequency is approximately 256 kHz.

The 4-digit security code is stored in the 24LC00 EEPROM (IC2). The EEPROM contains 256 bytes of data, of which only the first five are used. As each key on the keypad is pressed, the PIC captures the event and translates the key press into a hexadecimal code, which is compared against the codes read from the EEPROM after a power up.

EEPROM address 0 contains the last digit in the 4-digit security code. For example, if the security code were 1-2-3-4, address 0 would contain the digit 4 (0 × 04), while address 1 contains the third digit of the security code; address 2 contains the second digit and address 3 contains the first digit.

EEPROM address 4 contains the inverted sum of all four digits. That value is used to validate the stored security code. If the inverted sum of addresses 0 through 4 does not equal the value stored in address 4, the code is marked invalid and the EEPROM rewritten with the default code—1-2-3-4. That's how the Padlock initializes the EEPROM for the very first time. In our example of 1-2-3-4, address 4 would contain INV(0 × 1 + 0 × 2 + 0 × 3 + 0 × 4) or INV(0 × 0A) or 0 × F5.

Resistors R13 and R14 (10K units) are used to pull the EEPROM's clock (EE_SCL) and data (EE_SDA) lines (IC1 pins 1 and 2, respectively) to 5 volts when not in use. Communications to and from the EEPROM take place over those two lines. The data line is bi-directional—meaning that the PIC can use the line to communicate with the EEPROM and the EEPROM can use the line to communicate with the PIC. Obviously, something has to ensure that the two won't wind up trying to talk at the same time! That task is accomplished through the

TABLE 1—RELAY ELECTRICAL SPECIFICATIONS

PARAMETER	VALUE
Initial Contact Resistance, Max. (6V @ 1A)	30 milliohms
Normal Switching Capacity	8A @ 250VAC, 5A @ 30VDC
Max. Switching Power (resistive)	2000VA, 150W
Max. Switching Voltage (resistive)	380VAC, 125VDC
Max. Switching Current (resistive)	8A
Coil (polarized) 20° Celsius	192mW Min., 300mW Nominal

use of a serial communications standard, known as the Inter-IC Communications protocol or I²C, for short.

The I²C protocol consists of a two-wire serial interface developed as a joint venture by Philips and Signetics. The original specification, or "standard mode," was developed for data-transfer rates of up to 100,000 bps. An enhanced specification, or "fast mode," supports data transfers of up to 400,000 bps. Both standard and fast modes can coexist on the same serial bus. I²C operates in the standard mode. The I²C interface uses a comprehensive protocol to ensure reliable transmission and reception of data. When transmitting data, one device is the "master" (generates the clock), while all other devices on the bus act as "slaves."

In the Padlock, the PIC is always the master device, initiating all data transfers. The EEPROM is always the slave device, responding to the PIC's commands. In the I²C interface protocol, each device has an address. When a master wishes to initiate a data transfer, it first transmits the address of the device with which it wishes to communicate. All of the slave devices "listen" to see if it's their address, but only the target device responds.

Within the address field, a bit specifies whether the master wishes to read from or write to the target device. In the case of IC2, the EEPROM, there is a fixed constant in the address field. That's because IC2 was designed to be the only slave device on an I²C interface bus and, therefore, it does not require an address. In all cases, however, the master device generates the clock for the data transfer. For more detailed information on the I²C protocol, refer to the Microchip databook or to the Phillips/Signetics document, "The I²C Bus and How to Use It."

The keypad (KP1) for the Electronic Padlock is a 4-row by 3-column encoded unit that contains a total of 12 keys, designated 0 through 9, plus the "#" and "*." As each key is pressed, IC1 decodes the signal generated by the pressed key and checks to see if the correct security code has been entered. Resistors R1 through R3 are used to pull the column terminals of the keypad to 5 volts. Resistors R5 through R8 are used to pull the row terminals of the keypad to ground. Therefore, when the keypad is idle (no keys being pressed), the column terminals are at logic high (+ 5 volts), while the row terminals are a logic low (0 volts).

The relay (RY1) is used to control whether the equipment (or load) connected to the Padlock is energized or de-energized. You can think of the relay as nothing more than a switch. Energizing the relay's coil turns the switch on. De-energizing the relay's coil turns the switch off. The relay specified can handle up to 8 amps at 250 volts AC or 5 amps at 30 volts DC. Refer to Table 1, "Relay Electrical Specifications," for more information.

PARTS LIST FOR THE ELECTRONIC PADLOCK

SEMICONDUCTORS

IC1—PIC16LC54A microcontroller, integrated circuit
IC2—24LC00 CMOS 16 × 8 serial EEPROM, integrated circuit
IC3—LM317L positive, low-power, adjustable voltage regulator, integrated circuit
Q1, Q2—ZTX451 medium-power, NPN silicon transistor
D1–D5—1N4148 general-purpose, small-voltage, silicon switching diode
D6—1N5241 11.0-volt, 0.5-watt Zener diode
LED1—Light-emitting diode (green)
BZ1—Piezoelectric buzzer (Digi-Key #P9915)

RESISTORS

R1–R8, R12–R14, R17—10,000-ohm
R9—680-ohm
R10—120-ohm
R11—180,000-ohm
R15—240-ohm
R16—750-ohm
R18—1500-ohm
R19—2700-ohm

CAPACITORS

C1, C3—0.01-µF
C2—330-pF
C4, C5—1-µF

ADDITIONAL PARTS AND MATERIALS

KP1—Keypad, 3 × 3 (Digi-Key #GH5001)
RY1—SPST relay (Digi-Key #DSP1A-DC5V)
H1—Two-position header (Digi-Key #A19370)
J1—AC/DC connector (Mouser Electronics #16PJ011)
B1—9-volt NiCd battery (Digi-Key #P148)
Printed-circuit materials, enclosure, front label, 8-pin cable assembly, AC/DC power pack (part #T509, see text), 9-volt connector (part #BS6I), shorting jumper (part #929950), red and black hookup wire, solder, hardware, *etc.*

Note: The following items are available from JV Enterprises, PO Box 370, Hubbardston, MA, 01452; e-mail: *jventerprises@worldnet.att.net*. A complete kit containing all items listed above (excluding B1), which includes an undrilled chassis, front-panel label, AC/DC power pack, double-sided printed-circuit board with solder mask and silk-screen, programmed PIC with assembly source, 35 page "Users Guide, Assembly and Technical Reference Manual," containing complete schematic diagrams, foil pattern, and unlimited technical support for $78, plus $5 postage and handling. Add $10 for an assembled and tested unit. Standard kit containing all components listed above (except the enclosure, front-panel label, and AC power brick) for $60, plus $5 postage and handling. A programmed PIC16C54A with microcode, and HEX file for $8, plus $3 shipping and handling. Complete printed documentation package, 35 page "Users Guide, Assembly and Technical Reference Manual," complete schematics, foil patterns, unlimited technical support for $8, plus $3 shipping and handling. Enclosure (undrilled) with color label (black plastic box with 9-volt battery compartment) for $10, plus $3 shipping and handling. Double-sided printed-circuit board with silk-screen, plated-through holes, solder mask for $13.50, plus $3 shipping and handling. Massachusetts residents must add 5% sales tax.
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Figure 2 shows how the device to be protected should be connected to the Electronic Padlock. For AC loads, your equipment should be connected to the relay contacts as illustrated in Fig. 2A; while Fig. 2B shows how to connect DC loads to the circuit. Make sure that the relay's specified limits are not exceeded. Doing otherwise could damage the relay or your equipment, and possibly injure yourself.

As with most relays, highly inductive loads can cause large voltage spikes when switching. The spikes can cause arcing, which can damage the relay and the connected equipment. Motors typically present a large inductive load. If the Padlock is used to switch a motor, it is a good idea to limit the current flow to about 1 amp. That helps to protect the Padlock and the connected equipment. If more than 1 amp is needed, surge suppressors and switching capacitors can be connected to help reduce the switching spikes.

If you are connecting an AC load, ***please be careful***. If you are not familiar with the safety practices used when working with AC voltages, find someone who is—AC voltage can and does kill. Remember to always switch the live or hot wire, not the neutral. Refer to the appropriate connection diagram in Fig. 2 for AC and DC loads.

Digital loads can be connected directly to the base of Q2. When the Padlock is locked, the base of Q2 is pulled to ground via pin 17 (RA0) of IC1. When the Padlock is unlocked, the base of Q2 is driven to 5 volts. If a digital load is connected to that terminal, removing the relay from the circuit greatly increases operating time if running solely from the 9-volt battery.

The piezoelectric buzzer (BZ1) is used as a beep generator when keys are pressed, as well as for various other functions. In order for BZ1 to produce sound, it must be excited (driven) from a 2.8-kHz sinewave signal. Transistor Q1 along with R9, R11, R12, and D1 form a feedback amplifier that oscillates at the exact frequency BZ1 requires.

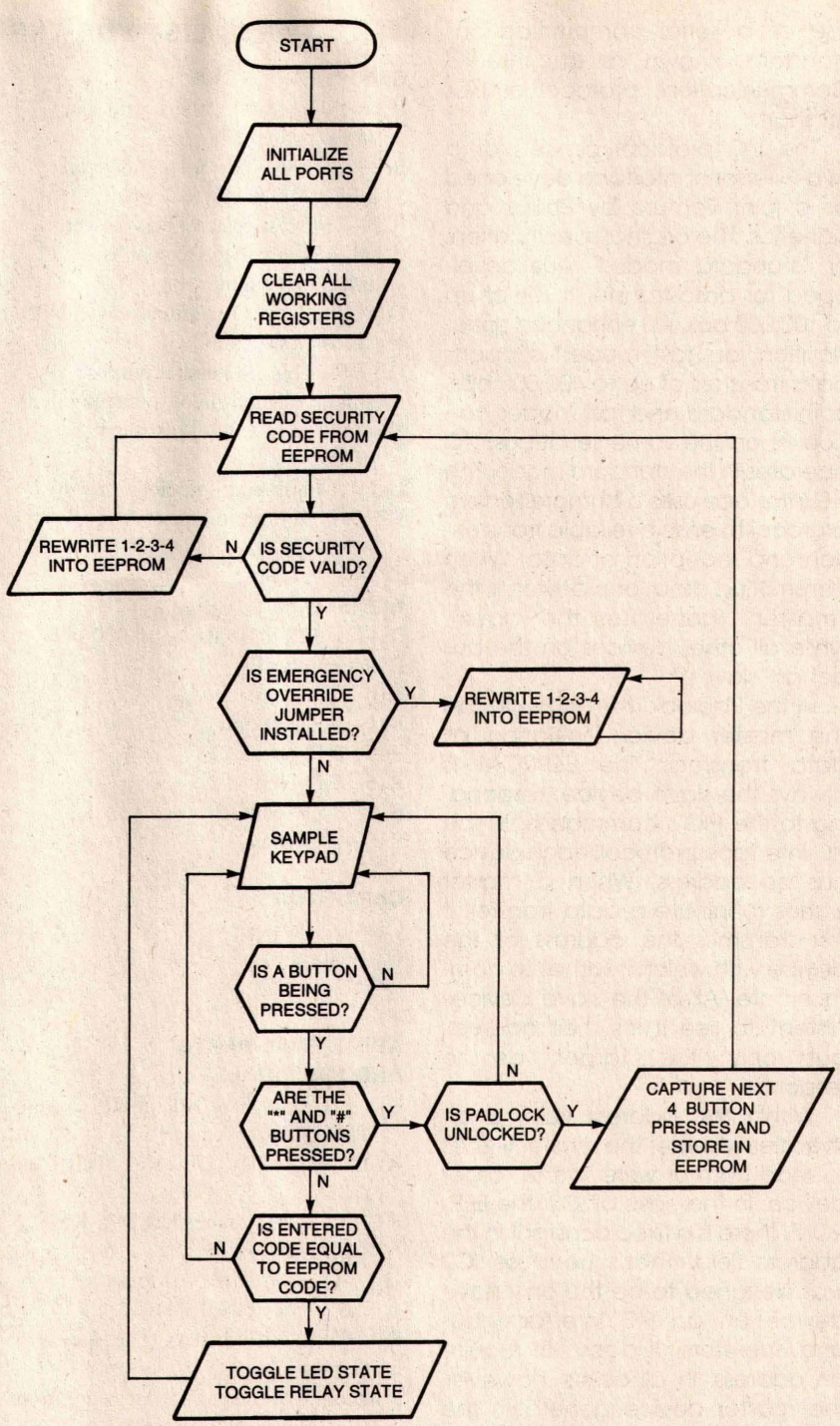

Fig. 3. Shown here is the firmware flow chart for the Electronic Padlock. (Refer to the text for a more detailed explanation.)

Power for the circuit—which can range between 7 volts to 18 volts—is provided by a 12-volt DC wall transformer. The circuit also contains a rechargeable 9-volt NiCd battery (B1), which is used to supply backup power to the circuit in case of a power outage. The battery charges from the main power source during normal operation. Note: If the source voltage dips below 10 volts, B1 may not fully charge.

When the Electronic Padlock is operating from the wall transformer R18 should be installed. That resistor trickle charges the 9-volt battery with approximately 4 to 7 milliamps. When the wall transformer is removed, or power fails, the 9-volt

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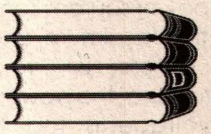

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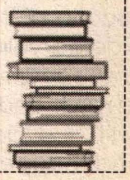

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battery operates the Padlock. Note: If a 9-volt NiCd battery is not installed in the Padlock, do not install resistor R18. Regular alkaline and carbon batteries do not like to be charged in this manner.

Diode D2 is used to block battery voltage from flowing to the main power source. Zener diode D6 limits the maximum charging voltage across B1 to 11 volts. Regardless of the power source, the raw voltage is fed to IC3 (an LM317LZ adjustable regulator), which is configured to limit the voltage to 5 volts. The 5-volt source is used to operate the rest of the circuitry. Capacitors C4 and C5 (1-μF units) are used to filter transients from the raw input and regulated output voltages, respectively.

Resistors R15 and R16 configure the adjustable regulator for a 5-volt output and keep a small amount of current flowing, which is required to stabilize the regulator. The light-emitting diode (LED1) is enabled by the PIC when the Padlock is unlocked. Resistor R10 limits the LED's current to approximately 24 mA. A 2-pin header (H1) is used as a security code emergency override. When a shorting jumper is installed on H1 and the Padlock is powered up, the PIC overwrites the security code stored in the EEPROM to 1-2-3-4.

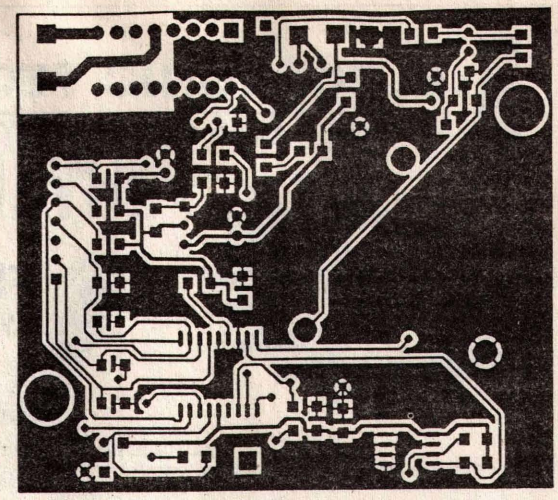
The Firmware. Refer to Fig. 3—the firmware flow diagram for the Electronic Padlock—during this portion of our discussion. When power is first applied to the circuit, the PIC (IC1) configures all of its hardware ports and sets up all of its internal working registers. Once that is complete, the PIC reads the first five locations from the EEPROM. Those locations contain the 4-digit security code. The PIC takes the first four values read, adds them together, and inverts the result (1s complement). If the result matches the value stored in EEPROM address location 5, the security code is considered valid. If it does not match, the security code is considered invalid, and the EEPROM is written with the default code of 1-2-3-4. That happens when the Padlock is powered on for the very first time since there isn't a valid code stored in the EEPROM. When the code has been rewritten for any reason, the PIC will re-read the code from the EEPROM in order to verify that the previous write was successful.

Once the security code has been verified, the PIC then examines the emergency override jumper. That's done by momentarily reconfiguring the pin normally used to drive the LED (RB7) to an input. The PIC then reads the value present on that pin. If the value read is a logic 0, the jumper is not installed and normal code operation begins. If the value read is a logic 1 (due to the pull-up now connected by jumper J7), the jumper is installed. Under that condition, the PIC rewrites the EEPROM with the security code 1-2-3-4 and waits. At that point, the user must repower the Padlock in order to return to normal operation.

Once the EEPROM and emergency override functions have completed, the PIC enters its main routine. That routine is responsible for sampling the keypad looking for key presses, comparing the entered code against the one read from the EEPROM, and toggling the state of LED1 and RY1 when necessary.

Since the keypad is encoded, the PIC must perform the following steps in order to determine which key(s) is being pressed. The PIC first drives the columns of the keypad to 5 volts and reads the voltages present on the rows. Next it drives the rows to ground and reads the voltages present on the columns. At that point, the PIC has successfully sampled the keypad and has enough information to determine which key(s) is being pressed. The whole sampling operation takes about 100 ms. Most of the 100-ms period is spent waiting in a tight code loop. That extended period of time ensures that the keypad's electrical signals have settled, and the PIC is not being fooled by key bounce.

Once the PIC has determined that a key is being pressed, it checks to see if the key(s) being pressed is the "#" or "*." If so, the user has tried to activate the program



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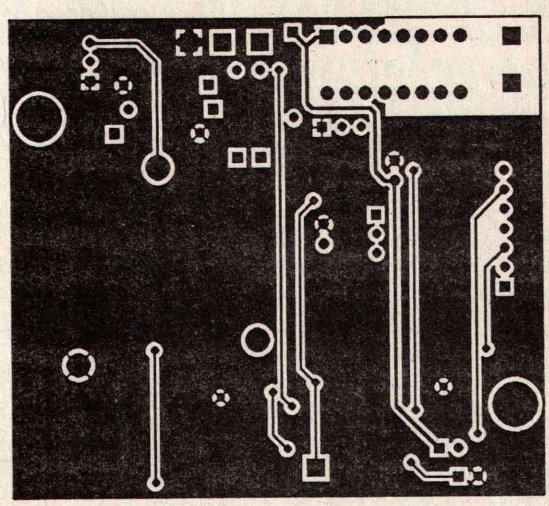

B

Fig. 4. The Electronic Padlock was assembled on a double-sided printed-circuit board, measuring 2 3/4 × 2 1/2 inches. Full-size templates of both sides of the unit's dual-pattern layout is shown here. The component side is shown in A, while the bottom layer is shown in B.

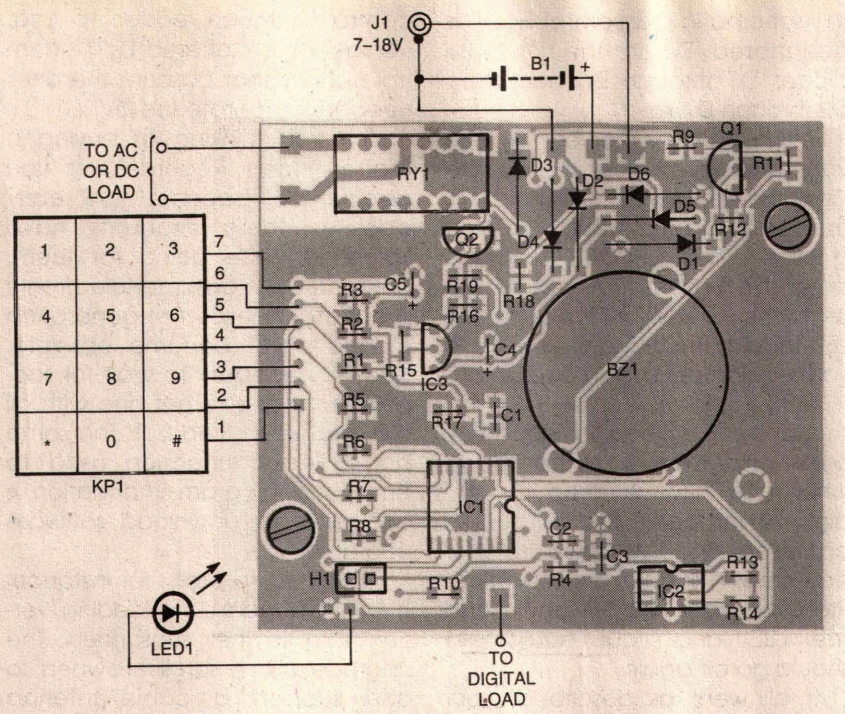

Fig. 5. Assemble the Electronic Padlock, guided by this parts-placement diagram. When assembling this project, be extremely careful of component placement and orientation, as the circuit contains several surface-mount components and you don't want to have to remove any of those tiny components due to construction errors of any form.

mode. The program mode is used to change the security code that is stored in the EEPROM. The program mode can only be activated if the Padlock is currently unlocked. If the unit is unlocked, the PIC beeps the annunciator three times and activates the program mode. The signals generated by the next four keys pressed are captured and stored to the EEPROM. If the unit was not unlocked when the user requested the program mode, the request is ignored.

Every time a key is pressed and the unit is not in program mode, the PIC compares that key press and the last three presses with the codes read from the EEPROM. When, and if, they match, the PIC beeps the piezo for 0.5 seconds and toggles the state of the LED and relay. That has the effect of either locking or unlocking the Padlock. The PIC won't sample the keypad again until the key being pressed is released. That helps to remove any key "repeat."

The assembly code and hex files for the Electronic Padlock can be found on the Gernsback FTP site at *ftp.gernsback.com/pub/pop/electronic-padlock.zip* or directly from the author at *http://home.att.net/~jventerprises*.

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Microchip Technologies' Web page, *www.microchip.com*, contains valuable resources for those who wish to modify the Padlock's firmware or develop their own. It also contains data sheets on all their microcontrollers and EEPROMs.

Assembly. The Electronic Padlock was assembled on a double-sided printed-circuit board, measuring $2^3/_4 \times 2^1/_2$ inches. A full-size template of the unit's printed-circuit layout is shown in Fig. 4. The component side of the board is shown in Fig. 4A, and the bottom layer is shown in Fig. 4B. Those who are skilled in etching double-sided boards can copy the foil patterns shown and use them to etch a board. For those not so inclined, a kit of parts for the Electronic Padlock is available from the supplier listed in the Parts List. Note, before you go any further, that many of the components used in the construction of this project are surface-mount units. If you have never soldered surface-mount components before, don't worry. This is a great introduction to surface-mount assembly. You should make sure you have a soldering iron with an extra fine tip, as well as thin (0.020 inch) solder, a magnifying glass, and tweezers.

Once you collected all of the components listed in the Parts List, construction can begin. Assemble the Electronic Padlock, guided by the parts-placement diagram shown in Fig. 5. Begin by soldering all passive components to the board first, followed by the semiconductors. Be careful to get component orientations correct the first time. Once all the components are installed, mount the circuit board in the chassis, connect the power cables, and connect your equipment (the load) to the appropriate pads.

The cable for the keypad specified in the Parts List is an 8-pin cable. Since the keypad only has 7 pins, cut one of the pins off before soldering to the circuit board. Once the assembly is complete, plug the DC power source into J1. (**Note:** If you are building the circuit from the kit, some component designations in the kit will differ from those shown here. For example, LED1 shown in the schematic diagram of Fig. 1, is designated D1 in the kit, with diodes D1 through D6 becoming D2 through D7.)

Assuming this is the very first time you have applied power to the Padlock with the EEPROM installed, the unit will beep 3 times indicating a write to the EEPROM. That write stores the 4-digit security code 1-2-3-4 to the EEPROM. At this point, the LED should be off and the power to your equipment should also be off.

Now press keys 1-2-3-4. You should hear a beep for each key press and then a longer beep when you have entered the 4th digit. At this point, the LED should come on, and the power to your equipment should be enabled. Press the code 1-2-3-4 again and the LED and your equipment should go off again.

If all went as described, your Padlock is ready for operation! Ω

HANDS-ON REPORT

(continued from page 7)

to record programs that it thinks you might like.

This can be a convenience for viewers who don't have the time or inclination to peruse pages of program guides. And TiVo sometimes finds some shows that really do fit your viewing profile. There's no need to worry about the hard drive filling up with TiVo's selections. When it needs to delete recordings to clear up disk space, TiVo always removes its own choices before any of yours. And, for anyone who finds it annoying (or spooky) to have a machine picking out programs, the feature can be turned off.

Comparison Shopping. There are a few other differences between the two systems. ReplayTV's buffer holds up to four hours of video, while TiVo's buffer holds only 30 minutes. ReplayTV also bested TiVo on picture quality and providing the ability to skip through commercials in 30-second increments. TiVo provides three speeds of forward and reverse playback: 3- 12-, and 60-times. TiVo also provides the ability to view slow-motion and frame-by-frame scenes, which sports fans surely will appreciate. TiVo's remote control is much easier to use; ReplayTV's is cluttered by TV-control buttons that obscure the ones needed to operate the DVR.

Are you thinking of buying a Digital Video Recorder? If you decide to become an early adopter, these products have something else going for them. Unlike most consumer-electronic products, these first-generation models won't become obsolete. Nor is it necessary to wait for successive models to get one with all the glitches worked out. The same phone-line connection used to download program information is also used to download software upgrades.

As we go to press, for instance, TiVo just began downloading version 1.2.1 to their subscribers. The upgrade allows satellite owners to also support a cable/antenna input, adds a message inbox to allow customers to receive messages from TiVo, allows users to specify at the time of recording how long a recording should be stored, and smoothes out the video during fast-forward and rewind at all speeds.

Be warned: Once you get used to the personalized TV experience, it's hard to go back.

For more information on ReplayTV, contact Replay Networks, 1945 Charleston Road, Mountain View, CA 94043-1201; 800-266-1301; *www.replaytv.com*; or circle 80 on the Free Information Card.

To learn more about TiVo, contact Philips/TiVo, 1000 West Maude Ave., 4th Floor West, Sunnyvale, CA 94086; 877-367-8486; *www.tivo.com*; or circle 81 on the Free Information Card. P

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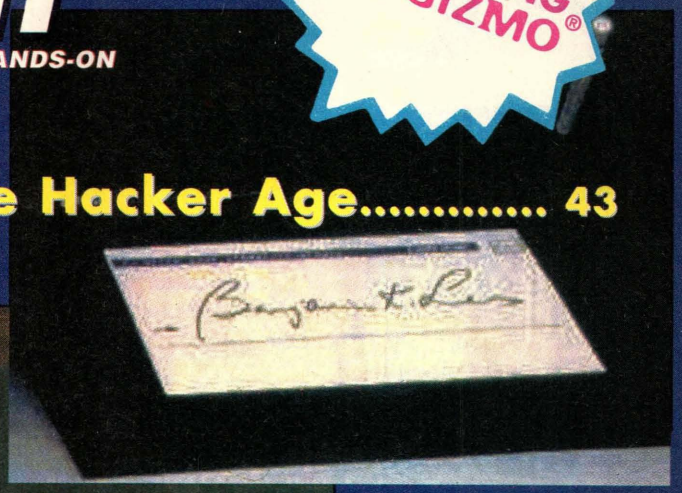

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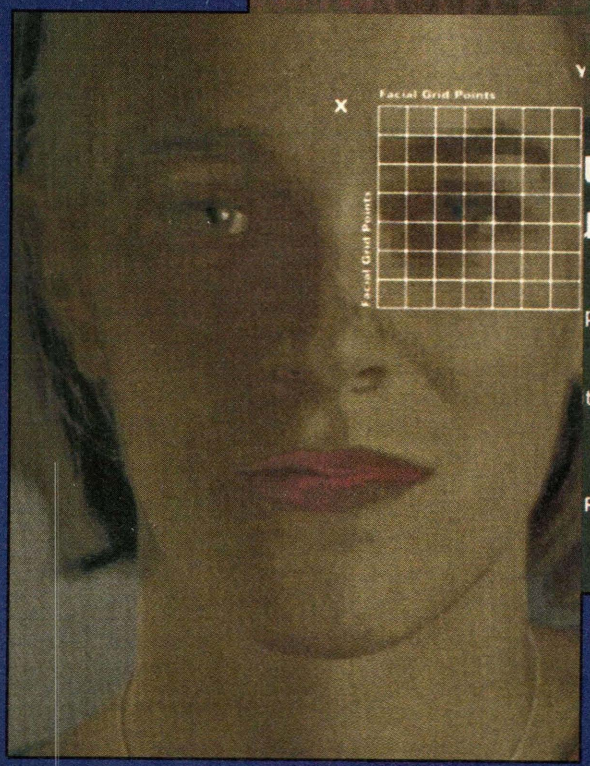

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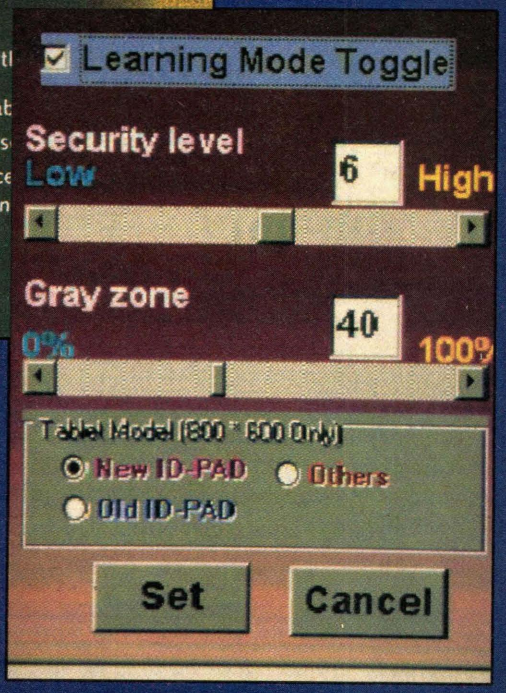

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A PC Tablet?

As great as laptops may be, their form factors are not suited for every application. If you need a mobile computer, but won't necessarily be able to use it sitting down, Aqcess Technologies has come up with the perfect solution. Called the *Qbe* (pronounced "cube"), it's the first Personal Computing Tablet to offer all the functionality of a Windows 98/NT multimedia laptop.

Measuring 14 by 10 by 1.5 inches, the Qbe is only slightly larger than a legal pad. Users can use the included stylus to navigate on the 13.3-inch active-matrix, color touch screen and even write thanks to the system's handwriting recognition. If you'd like to enter data faster, consider using the Qbe's voice recognition instead, which can have you entering up to 140 words per minute. The combination of pen and voice input results in wonderfully natural data-entry.

The introductory Qbe ($2995) is available with a 266-MHz Pentium II, 4GB hard drive, and 64MB of RAM. Other configurations will be available with up to the 600-MHz Pentium III chip, a 6GB hard drive, and memory to 512MB. All versions come with a Li-Ion battery that will provide up to four hours of life (an extra pack adds another four), as well as a docking station that offers full desktop functionality via a keyboard and mouse.

Aqcess Technologies, Inc., 3611 South Harbor Blvd., Suite 105, Santa Ana, CA 92704; 888-818-0055; *www.qbenet.com.*

CIRCLE 90 ON FREE INFORMATION CARD

Pro Video Studio

Own a Digital Video (DV) camcorder? These devices represent 40 percent of all new consumer video-camera purchases, no doubt thanks to their stellar quality. Now there's another reason to go DV or Digital8: these camcorders can be interfaced with a computer for advanced editing and eventual storage on media such as CD or DVD-RAM. All you need is an IEEE-1394 interface card and appropriate DV software—both of which are found in Pinnacle Systems' new *Studio DV* ($199).

The included PCI card adds three high-speed IEEE-1394 ports to your system. Connect your camcorder to one of these interfaces and you're all set to capture video. Unlike "professional" DV editors, Studio DV captures video at preview quality, storing an entire 60-minute tape in only 150MB of hard-drive space. It is this content that you can cut, rearrange, add titles and effects to, and even mix with a music or narration track. Editing is made simple with the program's Storyboard system that lets you visually arrange movie elements and scenes.

When you're finished editing, Studio DV captures the full DV content from your camcorder, thereby sparing your hard drive from data you were just going to delete anyway. Incidentally, you'd better have some free room on your system for the final process, as full DV is captured at 240MB per minute! But the finished product couldn't look better.

Pinnacle Systems, 280 North Bernardo Ave., Mountain View, CA 94043; 650-526-1600; *www.pinna clesys.com.*

CIRCLE 91 ON FREE INFORMATION CARD

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Pen-Sized Scanner

Capturing data from printed documents cannot always be done from the comfort of a desktop. Whether you're digging up facts at the local library or bookstore or finding yourself encumbered by loose business cards on a trip, having a portable scanner can be a tremendous help. Turn all that paper-based information into data that you can easily carry and even transfer to your computer with C Technologies AB's *C Pen 200* (under $200, street).

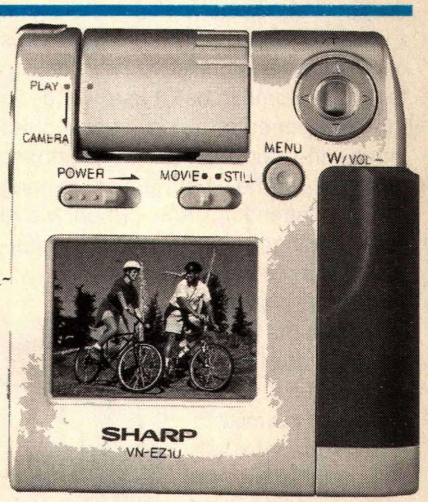
The C Pen 200 has a built-in Intel StrongARM 100-MHz processor and optical-character recognition (OCR) software engine. As a result, the device can read up to 100 characters per second, storing them as editable text. Using the C Pen 200 is as easy as using a highlighter. Just drag the sensor across the words you want to capture. As long as the text is 7 to 20 points in size, and in a standard typeface (no calligraphy or handwriting), accuracy is dead on.

With its built-in 2MB of memory, the Pen allows you to store up to 100 pages of text, which you can later transfer via infrared to your computer. But there's no need to always do so. The terrific user interface of the C Pen 200 lets you organize all those pages of data, making it more than a mobile scanner. It's a personal data assistant with an eye.

C Technologies AB, Ideon Research Park, Scheelevagen 15, SE-223 70 LUND, Sweden; *www.cpen.com.*

CIRCLE 92 ON FREE INFORMATION CARD

MPEG-4 Camera



Untethered as it may be, Sharp's new *VN-EZ1U Internet Viewcam* ($699, MSRP) is the world's first digital motion picture and sound camera designed specifically for the Net. Capture sights and sounds, then use them on Web pages, send them via e-mail, or just watch them onscreen. The included SmartMedia Floppy Disk Adapter makes it a cinch to transfer content to any computer.

The VN-EZ1U is the first digital camera to use MPEG-4 compression standard, making it possible for the camera to hold up to an hour of video with sound on a 32MB SmartMedia memory card (the unit comes standard with a 4MB card, providing only 7 minutes of storage). Using Microsoft's Advanced Streaming Format (ASF), your recordings can be viewed and heard with *Windows Media Player 6.0* (or higher) as they're being downloaded from a Web site or Intranet page.

The Viewcam comes with a 4X digital zoom for recording and a built-in microphone. Thanks to the 270-degree rotating camera lens and 1.8-inch LCD monitor, you can shoot in almost any direction (including at yourself) and still monitor what's being recorded. And you can do so just about anywhere, as the VN-EZ1U measures just 3.2 by 3.5 by 1.7 inches and weighs a mere 8.5 ounces with the included four AA batteries installed.

Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; 800-BE-SHARP; *www.sharp-usa.com.*

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Call-Waiting Modem

Actiontec
56K External
Call Waiting Modem
Receive Phone Calls While Online & Maintain Your Internet Connection
NEVER MISS A CALL!

The Internet has brought us a lot, including busy signals. If you have one phone line and would like to be reachable while online, check out *Actiontec's 56K External Call Waiting Modem* ($124.99).

The unit connects to an open serial port (a USB version is also available) and offers full high-end modem functionality, including: answering machine with multiple voicemail boxes and remote message retrieval, fax send and receive capability, as well as V.90 and K56flex support for high-speed downloads. However, you also get a wonderful extra.

Whenever the phone rings, you can answer it and see who's calling. If it's someone you'd rather not chat with, you have about seven seconds to hang up without losing your Internet connection. To talk with whomever's calling, just let the modem hang up your connection. As long as you don't close down your browser, you should be able to dial up again and resume your Web quest from the same spot.

Actiontec Electronics, Inc., 760 North Mary Ave., Sunnyvale, CA 94086; 408-752-7700; *www.actiontec.com.*

CIRCLE 94 ON FREE INFORMATION CARD

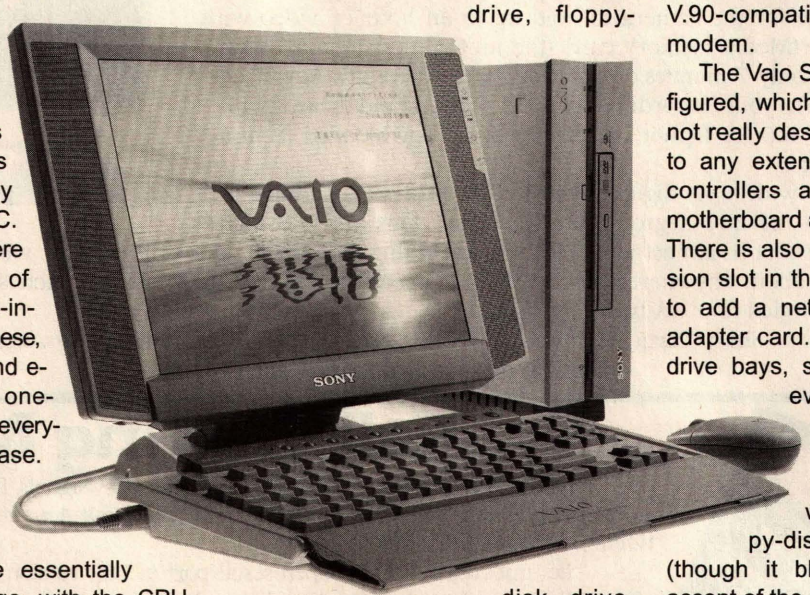
SYSTEM DESIGN

TED NEEDLEMAN

Sony Vaio Slimtop PCV-L620

Welcome to the first installment of our new column on system design. Each issue, we'll take a look at a desktop or laptop that incorporates one or more significant new design features. Sometimes, these will be in the components being used; other times, the form factor or aesthetic approach will be what we want to bring to your attention. And, when we're lucky, we'll get a product that is different in both of these respects.

That's just the case with the Sony *Vaio Slimtop PCV-L620* that we've chosen for this month's focus. One look tells you that this isn't any ordinary desktop PC. In recent months, there has been a spate of introductions of "all-in-one" PCs. Some of these, such as the iMac and e-Machines' similar one-piece PC, package everything into a large case. Others, such as the NEC Z-1, Gateway Profile, and Chem USA's PC3000 are essentially laptops built on edge, with the CPU, drives, and other components mounted behind the LCD panel. The Vaio Slimtop falls into a different category than all of these.



As with today's coolest PC designs, the Vaio Slimtop offers a 14.1-inch LCD panel that's digitally driven from an ATI RAGE LT PRO 2X AGP chipset with 4MB of video RAM. On the particular model we tested, however, you must use Sony's LCD—there is no output for a standard CRT. You can, however, also order a version of the Vaio Slimtop without the LCD panel display, which features a standard analog video output.

Along with the LCD monitor, the remainder of the Vaio Slimtop system is in a tiny case, not much larger than a cigar box. Inside this case are the motherboard, hard-disk drive, floppy-disk drive, and a 6X DVD drive. The box can be placed normally, like a tiny AT-style case, or you can attach a special base that allows the case to be mounted vertically on its edge. Since the case is only 3.5 inches wide, the combination of LCD panel and case takes up incredibly little desk space.

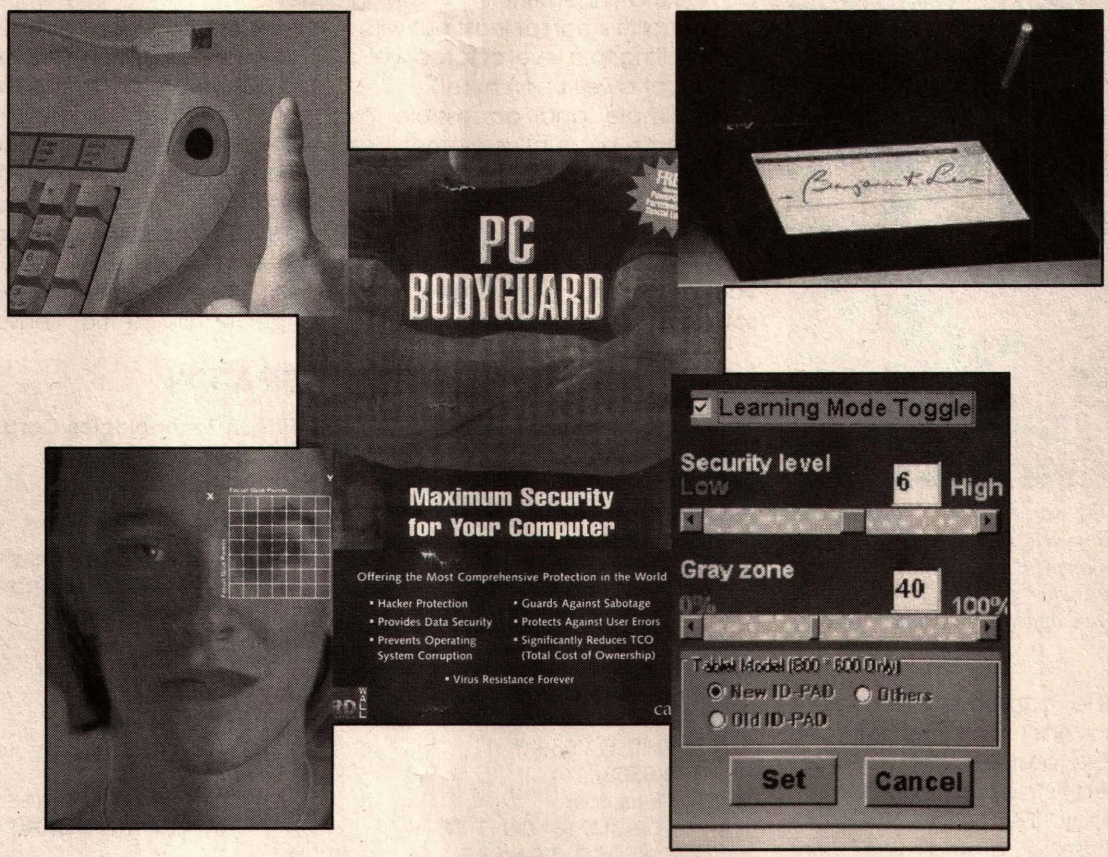
SMALL IS GOOD

As innovative as the Vaio Slimtop may be, it, of course, has some conventional features. The motherboard, while smaller than even a micro-ATX form factor, uses standard Intel 440BX core logic, and houses a very fast 500-MHz Pentium III CPU. Standard memory on the Vaio Slimtop is 128MB, with a maximum capacity of 256MB of standard PC100 DIMMs. Also included is a V.90-compatible, 56-Kbps fax/data-modem.

The Vaio Slimtop is very nicely configured, which is a good thing, as it is not really designed to be upgradeable to any extent. The video and audio controllers are embedded into the motherboard and are not upgradeable. There is also only a single PCI expansion slot in the case, should you want to add a network interface or SCSI adapter card. There are no additional drive bays, so unless you intend to eventually replace the 10.8GB Ultra DMA hard-disk drive, you are pretty much stuck with it. A standard floppy-disk drive is included (though it blends so well into the accent of the case that you really have to look for it), as is a 6X DVD drive. The ATI video chipset provides some hardware motion compensation, which helps smooth out full-screen DVD playback. But MPEG decoding is performed in software, by the DVD Express utility that's included for this purpose.

(Continued on page 58)

Computer Security in the Hacker Age



KONSTANTINOS KARAGIANNIS

Your PC may be a target for information thieves and prying eyes. Learn what you can do to keep your files and data safe from invasion.

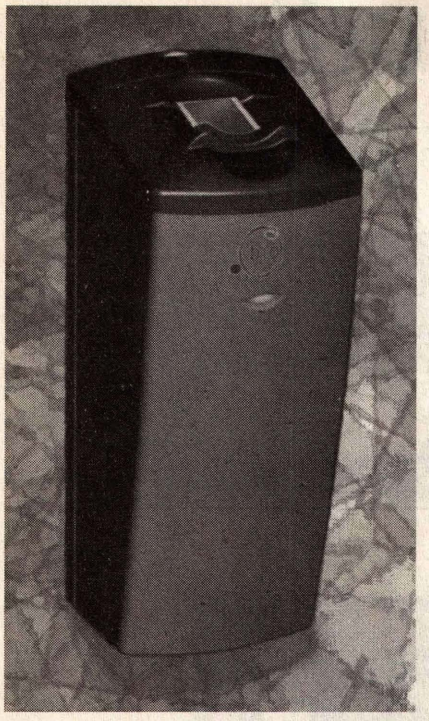
The adage that knowledge is power has never been truer. Whether you're an employee of a large corporation or someone who's entered a credit card number into a PC, the data on your machine's hard drive is valuable. With such information, others can do quite a bit of damage to you. Also, should some devious hacker decide to only tamper with and not steal that data, you can be left in quite a bind without a specific report or spreadsheet.

Sure you can back up your data often just in case a virus or other disaster strikes, but what can you do to prevent that data from getting into the wrong hands? Just like knowledge can be used for technological malice, you can apply modern security knowledge to lock up your PC from the outside world.

To this end, in the pages that follow we'll be sharing some computer security methods that are either available or on the horizon. From biometrics, which uses physical traits of users to distinguish who should or shouldn't have access to a machine, to advanced software designed to repel all invasive attempts automatically, you're sure to find a suitable security solution somewhere in the following pages.

So awaken a healthy amount of paranoia and read on to learn what you can do to ensure your fears are for naught. Get ready to protect your PC.

Fingerprinting. One of the most personal traits we own is a fingerprint. Banking on this individuality, manufacturers have been releasing enterprise and consumer scanners that can identify us by the swirls, whorls, and other patterns found on our fingertips (these marks of identification are often called minutiae points). Interfaced to a computer, such scanners help the machine "decide" what resources to allow a user access to, if allowing any access at all.



Some of the world's largest corporations rely on Biometric ID's Veriprint 1000 for their fingerprint-recognition security needs. Consumer products similar to the Veriprint are appearing on the market as well.

On the consumer side, giant Compaq has come up with an affordable and easy-to-use product called *Fingerprint Identification Technology* ($99, MSRP). The product consists of a small fingerprint scanner (kind of like a mouse with an "eye" on top) and a program called *Identicator*. The package will work with Windows 95/98/NT, and on any PC capable of running one of these operating systems.

The scanner contains an optical CMOS camera and connects to your PC's keyboard and parallel ports. Note that the there is no passthrough provided for the parallel port, so if your system doesn't have two of the latter, you won't be able to use a non-networked printer or a parallel-interface storage device like a Zip. Your options in this case are to either look to USB peripherals for such applications, or maybe get a parallel-port add-on card for your machine (Compaq offers one of these as well).

The *Identicator* software provides a high level of security, carefully discriminating the fingerprint that the scanner presents it with and allowing access only to users who have the right fingerprint. Incidentally, the program only stores one finger per user, so you have to use the same finger each time, as each finger has a distinct print. Unlike username/password combos, a fingerprint is something a thief can't steal (at least not without resulting to a level of force we'd rather not dwell upon here!).

As simple and accessible as Compaq's product is, sometimes security applications are as personal as fingerprints. This means that not every user is willing to settle for an out-of-the-box solution. Whether you're working with ultra-custom software or are a bit of a mad scientist at heart, you may want something a bit more "tinkerable."

Biometric Identification, Inc. has released a customizable security device, called the *Veriprint 1000*. It's perfect for a do-it-yourselfer who would like to adapt a biometric device to a custom application, from simple logon protection to software interaction (for example, use a thumb print to access specific files or folders). Biometric ID provides developer kits for advanced users and works with manufacturer partners to provide commercial solutions for major companies like Intel and Unisys.

At the heart of the unit is the FingerTIP biometric sensor chip

VENDOR INFORMATION

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Sherman Oaks, CA 91403
818-501-3908
www.biometricid.com
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Using TrueFace PC, *you can affordably protect your own computer with face recognition that's on par with security systems costing thousands.*

from Infineon Technologies (formerly Siemens Microelectronics), which Biometric ID has packaged in a self-contained fingerprint-verification module called the *MV1100*. The total standalone module is smaller than a business card and incorporates an image capture area the size of a stamp.

The FingerTIP chip is a small (18 × 21 × 1.5 mm) IC embedding a 288 × 224-pixel contact sensor array that images the lines and ridges of a fingerprint when a user touches the device. Each pixel has an 8-bit data depth, enabling evaluation of subtle gradations (256 shades of gray) of a fingertip and their translation into a set of indices or key identifying minutiae points. Imaging and data transfer of an impression takes only 100 milliseconds. The chip also incorporates extensive electrostatic discharge (ESD) protection features, making it able to withstand static electricity jolts of up to 8 kilovolts.

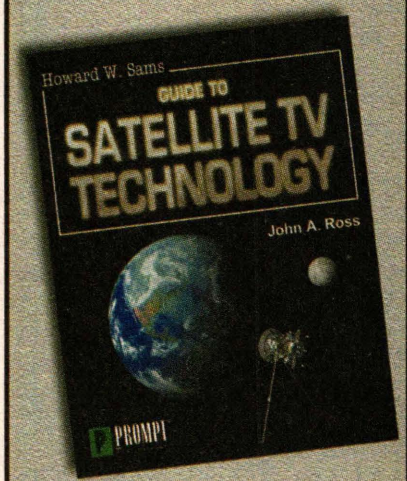
If you're interested in taking advantage of the FingerTIP and Biometric ID's implementations of it, contact either this company or Infineon.

Another company offering a fingerprint scanner for developers is Polaroid. What's interesting about this vendor's *PFS-100* is that it works with a USB interface. As a result, expect to see many manufacturers incorporating the sensor into affordable desktop solutions. And they'll be dependable products, too, as the PFS-100 has a 500-dpi CMOS imager, which has a geometric distortion of less than 1 percent over the entire image field.

Look Into the Camera. Science fiction fans have come across more than a few movies where a character looks into a retinal scanner to gain access to some guarded room. Thanks to a few innovative products, this form of visual, facial biometrics is no longer an imaginary concept.

While retinal scanners are available, they can cost as much as $6000, because of the multiple, high-resolution camera system needed for them. The most inexpensive form of visual ID by far comes in the form of total-face comparison software. Commercial applications already exist for this

EXPAND YOUR KNOWLEDGE



GUIDE TO SATELLITE TV TECHNOLOGY
by John A. Ross

This book covers all aspects of satellite television technology in a style that breaks "tech-talk" down into easily understood reading. It is intended to assist consumers with the installation, maintenance, and repair of their satellite systems. It also contains sufficient technical content to appeal to technicians as a reference.

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technology, with major companies like Polaroid developing systems for motor-vehicle licensing departments and other organizations.

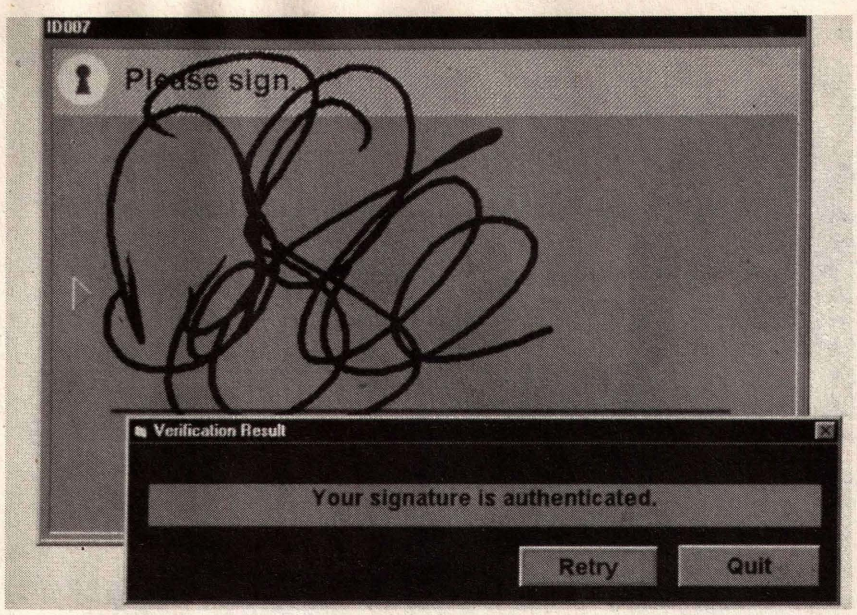
In the home, there's an affordable option. Using a standard parallel or USB PC camera (such as the type used for videoconferencing), commercially available face-recognition software can tell if it's really a legal user sitting in front of a particular machine.

Apparently the best package for consumers is *TrueFace PC* ($59.95) from Miros, Inc. The company offers enterprise-level solutions, too, but for your own computer *TrueFace PC* is hard to beat. It will work with a Pentium 90 or better that has 16MB of RAM, Windows 95 or 98, and, of course, a camera. The latter need be only a modest unit that can capture a face image of 80 pixels or larger. You'd be hard pressed in today's marketplace (or even that of last year) to find a camera that didn't meet this minimum. Often, you can get one for well under $100, if not for half that much.

TrueFace PC has a simple setup that asks you to turn your head in various ways. After it captures various views of you, it will form an internal register of your face's key identification points. Up to ten users can be specified, should you want different family members to have access, for instance.

Some clever readers might be wondering if holding a photo up to the PC's camera could fool *TrueFace*. Not a chance. The software needs you to move your head and turn it for verification, so no still photo would fool it. Actually, no videotape of you would work either, as pointing a camera at a monitor or TV playing such a tape would result in flashing. The only way around this would be for a vandal to perfectly match the camera's frame-per-second capture rate to the refresh frequency of the playback monitor—unlikely, as monitors refresh at 60 or more times a second, and camera's capture 30 or less frames per second.

In addition to logon protection, *TrueFace PC* can also be used to lock your screensaver while you're away. If you're worried about face-verification slowing you down, especially after each time your screensaver kicks in, have no fear. The ID process takes only two or three seconds on most computers, and even less on the fastest PII and PIII systems.

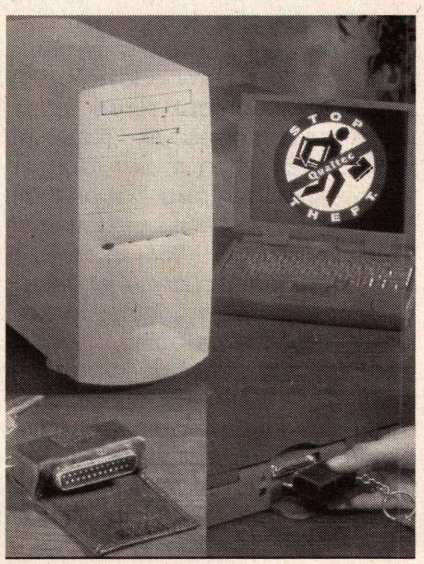


Signature recognition, being constantly improved by companies like Cyber-SIGN, is an important security technology for applications like online banking and message-sender ID verification.

Sign Here, Please. Another biometric way to lock a system is through the use of signature recognition. Unfortunately, to do this you need to have a signature-capture device or tablet with enough resolution and sensitivity to tell your John Hancock from that of a clever imitator. Because of the costs associated with such a device, signature-recognition systems have been released in network-only versions, where volume discounts can take effect. However, we still wanted to touch briefly on one such system to illustrate a more full overview of biometric applications.

Named for its pursuit of this aspect of ID technology, Cyber-SIGN, Inc. has developed a system (also called *Cyber-SIGN*) that can verify identity not only by the shape of a signature, but by the way it was written in real time. Running over a server (either in a network or over the Internet), the software registers the timing changes in pressure, shape, direction, and speed in the signature-verification process. Even if a thief managed to get your signature just right in appearance, Cyber-SIGN claims it would be very difficult for him or her to get these other particulars just right.

Now, not everyone signs things the same way twice, and some users may have more erratic handwriting than others. For this reason, users can set up the percentage or level of discrimination that the software uses to compare signatures.



Try locking up your PC with the Data Defender—it's as easy to use as the key that opens your front door. When it's not in your system's parallel port, the machine won't boot.

Times Are Tough...

Today's headlines scream of the lack of qualified individuals to fill new and existing high-tech job openings. If you feel the robust economy is passing you by, there is something you can do about it. **Become CIE Qualified.** Since 1934, The Cleveland Institute of Electronics has been providing its students with the necessary technical and academic credentials employers are seeking. In fact, CIE was started in 1934 to fill a similar void in the radio/television industry.

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Of course, you shouldn't set this discrimination too "loose," or else security once again becomes an issue.

Because it runs over a secure server, Cyber-SIGN technology may provide a great solution for online banking and other business scenarios where a signature is needed to close a deal. If you run a network and would like to learn more about enterprise setups from Cyber-SIGN, feel free to contact them.

Lock and Key. Moving away from the world of biometrics, we come to a paradigm that's been in use for centuries, and which can still work for certain applications. You use this paradigm every time you return to an empty home or start up your car: the trusty lock and key.

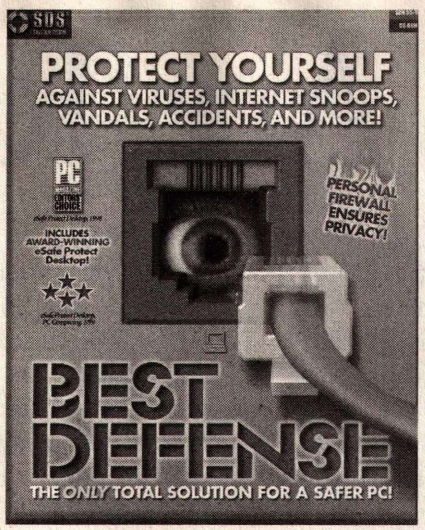
Curtis Computer Products recently introduced a great solution for both desktop and laptop data security—a way to ensure that no one else can ever access your data, even if your machine is stolen. The *Data Defender* ($149.95) is about the size of a cigarette lighter, yet as potent as a room-sized vault when it comes to protecting your computer.

To use the Defender, you install the security program it comes with onto your hard drive. This app embeds a driver deep into Windows 95 or 98, making it impossible for a devious guest on your machine to remove. With the driver loaded, there's only one way to boot your computer: The Data Defender key must be plugged into the parallel port.

Each Defender key is coded, so another person with a similar device cannot start your system. Should a thief take your computer or even just your hard drive, he or she will be unable to access any of the data on the drive without the key.

Since most parallel ports on desktops are out of reach, Curtis also offers a *Parallel Port Extender* ($29.95). This dongle cable makes it possible to have a parallel port of sorts on your desk, making it a cinch to connect your Defender. Furthermore, the Extender has a parallel pass-through, allowing you to attach a printer.

While the Data Defender won't be able to return a stolen computer (none of the products we look at here do that), it will render it useless to anyone else. Further, for day-to-day protection from those just passing by your terminal, it's a wonderful product for keeping others out of your system.



Protect your PC from Web sites that may contain hostile code with SOS Best Defense, *the only software package that handles anti-virus, anti-vandal, and Internet-filtering tasks.*

Viruses, Internet Snoops, and More. We put our computers through the wringer these days. Once your machine was only suspect to physical information prying, and a good lock on a door plus a password would usually protect a computer. However, the modern wired world is one filled with perils. Downloading programs off the Net can be analogous to inviting a stranger into your home at three in the morning, and just visiting some Web sites can be as dangerous to your privacy as keeping all the blinds off your windows for 24/7.

How do you protect from viruses that can eat up data on your system or sites that want to capture a little too much information from your computer? With protective software, of course. The packages we looked at in this category offer protection against different types of system malfunctions, too, and can help you figure out if your machine is behaving buggy due to some troublemaker's influence.

Norton SystemWorks 2000 for Windows 95/98 Professional Edition ($99) by Symantec is a powerhouse bundle from the company that's been protecting computers since the first days of Windows. The suite contains full versions of: *Norton AntiVirus 2000 v6.0*, which is arguably the best virus protection around; *Norton Utilities 2000 v4.5*, a killer diagnostics and disaster recovery app that can even optimize system performance (depending on what's causing system slowdowns); *Norton CrashGuard 2000*, to keep your system running; *Norton CleanSweep 2000 v4.7*, for help uninstalling programs and removing unnecessary files; and *Norton Web Services*, which helps you update software and security apps on your machine.

This "Professional" version also has some handy bonuses worth mentioning. *Norton 2000* corrects for many Y2K problems that, depending on when you read this, may already be affecting your computer. For backup purposes (a security must!), you can rely on *Norton Ghost* for disk and file cloning. Another even more security-based feature is *Norton Secret Stuff*, which lets you encrypt e-mail.

Because of the suite's integrated interface, you can access all the aforementioned programs from a single window. Learn the basics of one and be able to easily use all. Also, we have to mention again that such a combo suite eliminates the guesswork about why your system is behaving erratically. And if it is a virus causing trouble, chances are *AntiVirus* will be able to clean it off.

As hinted at in the beginning of this section, viruses do not represent the only online dangers. To protect yourself against Web sites that may contain hostile code, you'll want to pick up Sterling Strategic Solutions' *SOS Best Defense* ($59.95). This is the only software package that handles anti-virus, anti-vandal, and Internet-filtering tasks. It even protects against certain types of tampering that can only be made "in person" on your machine.

Java and ActiveX controls are programs that run on Web sites and make visiting the latter more visually appealing and interactive. However, this code could contain viruses.

(Continued on page 58)

SELINA KYLE

CD-R Expands

It's not often that a technology can improve the enjoyment of life in seemingly unconnected ways, but CD-R has done just that. Both data and audio applications have made this one cool tech to own at the dawn of the new millennium.

As a data medium, CD-R has made it possible to store hundreds of megabytes of files in a virtually permanent way. With the advent of CD-RW, the ability to rewrite or overwrite data was added, meaning you didn't have to stick with one version of, say, a backup forever.

As an audio medium, CD-R has granted thousands the ability to mix tracks from or just plain copy CDs. And while audio-CD dubbing decks may limit the number of digital copies you can make of a disc, CD-R PC drives free you to dub as you please.

Now CD-R has gotten even better.

If you've hesitated at the thought of adding a CD-R drive to your PC before, reconsider. Memorex has introduced a "bigger" disc to take advantage of it. Upping the ante from 650MB/74 minutes, the new *CDR-DA* can handle 80 minutes of audio, as well as 700MB of data. The new discs have an MSRP of $27.99 in a 10-pack. Street prices may be lower, making the new CDs about $2 each in quantity.

Memorex even has a new CD-RW drive that will have you recording and rerecording (though CD-RW is still limited to 650MB) in style. As long as you have a Pentium 133 or better with 32MB of RAM and Windows 95, 98, or NT, you're ready for CD recording.

The Memorex CD-RW 4224 drive offers both speed and diverse functionality. Except for DVDs, there isn't a CD-sized media this drive can't handle, and handle well.

4X2X24X

Don't be stumped by the series of numbers in the subheading you just read. The new Memorex *CD-RW 4224* drive ($199, MSRP) has adopted the standard of indicating the different speeds at which it performs its different functions. Spec one, or 4X, shows that the drive writes to CD-R media at a speed of about 4X—in this case a range from 614–697 KB/sec. The second spec, 2X, indicates that the unit will rewrite to CD-RW discs at 300 KB/sec or 2X. The largest number, 24X, is the speed at which the drive can read all CD media; in this unit, at a maximum of 4233 KB/sec.

The drive comes with a software package, called *NTI CD-Maker Pro 3*, which makes it simple to archive data, create CD audio discs, and even make video CDs. While we were surprised that Adaptec's popular *Easy CD Creator* wasn't included, the NTI offering did work well and is suited to beginners and pros alike.

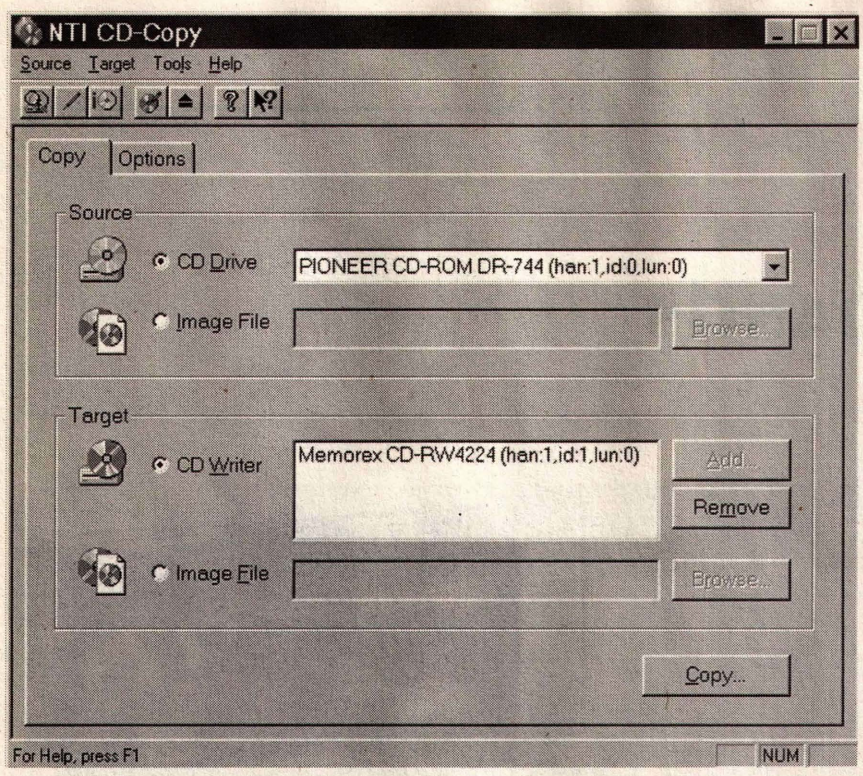
Also with the drive you'll find mounting screws and an audio cable to connect it to your system's sound card. Installation documentation is light, but we'll be handling the simple process here anyway.

BAY DECISIONS

Where will your new drive go? Because it reads at 24X speeds, the 4224 might make a good replacement for most older drives. However, if your installed CD-ROM is significantly faster, or you have a DVD-ROM drive, you will want to only add the 4224 as a second unit.

If replacing a drive, remove the old one from its bay by detaching the audio, data, and power cables, then unscrewing it from the side of the chassis (the drive will be held in by two to four mounting screws). You can then slide the drive out.

Check the back of the 4224 to see if it is set as a Master (the setting that tells your computer not to look for



Chances are you'll be making more than a few copies of CDs with your drive. CD-Copy *makes the process a matter of two or three mouse clicks.*

another CD drive). This is the standard factory configuration, but you will have to move the jumper if for some reason it wasn't set as such. The top of the drive has a label that shows you how to set the jumper.

When ready to install the drive in place of an old one, use the same cables and screws to make life easier, unless the old audio cable is incompatible with the Memorex drive. In that case, use the new cable. Insert the drive, make the three connections, and screw it into place. That's it.

Those of you installing the drive as a second unit will have to check to see if the IDE data cable attached to the original drive has a second connector. If so, you're set ... if not, go out and buy a ribbon cable with an extra connector before proceeding. Before you run out, though, check to see if you have a free power connector in your PC case. If not, add a Y cable adapter to your shopping list; this way you can siphon power from the other CD drive.

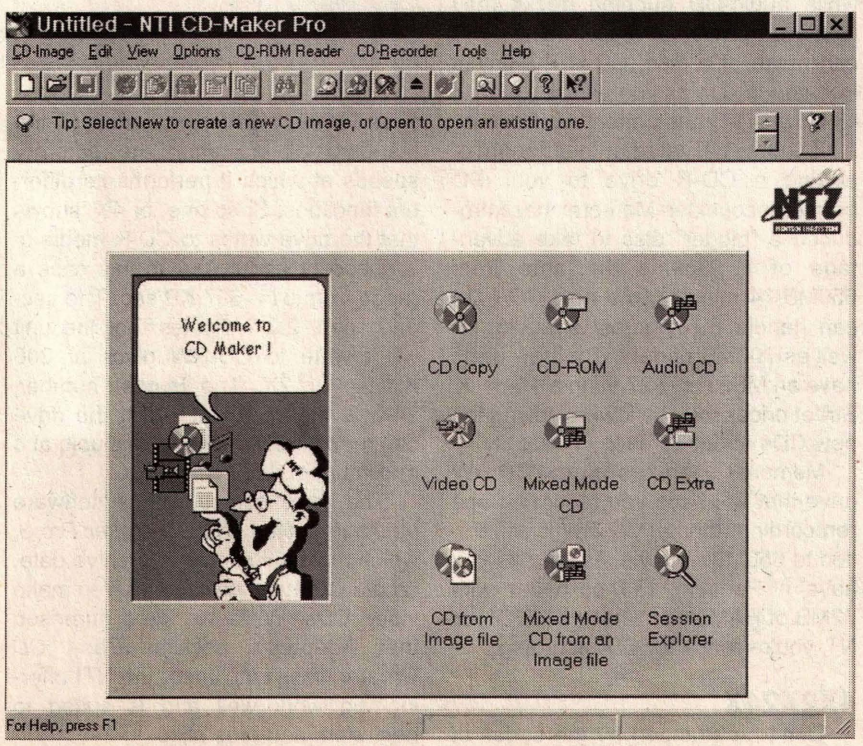
For those keeping that older CD drive, the Memorex unit will be an add-on device. This means that when added as a second drive, the 4224 will have to be set as a Slave (again, check the jumper diagram).

Insert the Memorex unit into an open bay and connect the data and power cables. Look for your system's sound card at this point. Does it have an auxiliary audio connector? If so, you can connect the new drive to it with the included audio cable. If not, you will have to make a choice as to which of the drives in your system you want to be able to play CD audio directly from, and connect only that one. The actual copying of CD audio is done as binary data (zeroes and ones) so you don't need to worry which drive you select for the privilege of playback capability. As most sound cards do have a second or even third connector, you may not have to worry anyway.

Once the drive is screwed into place, you're ready to boot your system.

WINDOWS KNOWS CD

Pay attention to your boot-up onscreen messages, and you may be surprised to find that your computer recognized the added drive. Further, when Windows loads, it will even assign a drive letter to your new addition. Network users experiencing a conflict as a result of this automatic assignment may want to change the chosen letter by going into Control Panel/System/Device Manager and finding the new drive under CD-ROM. Click on Properties and the Settings tab. You'll see drive-letter pull-down menus that let you pick a different assignment.


Untitled - NTI CD-Maker Pro
CD-Image Edit View Options CD-ROM Reader CD-Recorder Tools Help
Tip: Select New to create a new CD image, or Open to open an existing one.
Welcome to CD Maker !
CD Copy
CD-ROM
Audio CD
Video CD
Mixed Mode CD
CD Extra
CD from Image file
Mixed Mode CD from an Image file
Session Explorer
For Help, press F1

CD-Maker Pro *is designed to help even novices create perfect results every time, whether you're making a simple data backup or a mixed disc with audio and video files.*

VENDOR INFORMATION

Memorex
Memtek Products, Inc.
10100 Pioneer Blvd.
Suite 110
Santa Fe Springs, CA 90670
562-906-2800
www.memorex.com

CIRCLE 110 ON FREE INFORMATION CARD

After the new drive is set up, install the NTI software. Do so right off the Memorex drive to verify it's working. Installation is automatic once you run INSTALL.EXE on the CD.

The program package creates a folder in Start/Programs. Access it to click on one of the applications.

CD-Copy is the most straightforward program to use. If all you want to do is make an exact duplicate of a CD, this is the way to go. Here's where there's a benefit to having kept your original drive. You can select the former as the source drive and the Memorex as a target, thereby eliminating the need to copy data to your hard drive first; it's a great time saver. If you have already created a CD copy or *image* on your hard drive, though, you can of course select that as the source. Using *CD-Copy* couldn't be easier once your drives are selected. Press the Copy button and wait. A perfect copy is minutes away.

While it offers more functionality, *CD-Maker Pro* is anything but difficult to master. The opening screen is a Wizard that lets you select the function you want to perform. You can choose CD Copy, if you don't feel like opening the other app we just covered, or access a variety of other features. These include the choice of making a CD-ROM, Audio CD, Video CD, Mixed Mode CD (*i.e.* containing data and digital audio), CD Extra (a primarily music CD that will run as such, but which contains a data section), CD from Image file, or Mixed Mode CD from Image file. You are then guided step-by-step through the process. If you're new to CD recording, you will be thankful that Memorex chose this software package.

What about the rewriteable functionality? A special application, *FileCD*, is included to take care of the unique procedures involved in making a CD-RW. Use the program to add files incrementally to CD-RW discs or to delete files and folders on such media.

MAKING IT LOOK GREAT

In addition to the quality drive and extra-capacious 700MB discs, the folks at Memorex sent us another wonderful product that you might want to consider adding to your setup. Called the *CD LabelMaker Kit* ($29.99, MSRP), it's certain to make your discs look as professional as possible.

The kit comes with a program for PCs and Macs that lets you design killer-looking labels, which will print perfectly on the accompanying label paper. Included are 18 labels, but you can easily get refills.

After you print out your creation, place it on the cylindrical label applicator along with your CD-R or CD-RW disc. A gentle press will then perfectly center the label on the disc. High-quality results don't come much easier.

That's all the space for this month. Join us here next time for another look at improving that wonderful box on your desk. Until then, you can contact me care of *Peak Computing*, **Poptronics**, 500 Bi-County Blvd., Farmingdale, NY 11735, or directly via e-mail at *selinakyle@techie.com.* P

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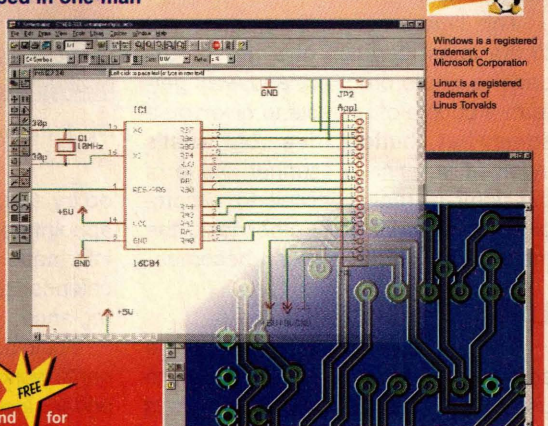
The crucial reason for selecting EAGLE is not usually the very favorable price, but rather the ease of use. On top of that comes the outstanding level of support, which at CadSoft is always free of charge, and is available without restriction to every customer. These are the real cost killers!



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EAGLE 3.5 Light is Freeware! FREE

You can use EAGLE Light for testing and for non-commercial applications without charge. The Freeware Version is restricted to boards up to half Eurocard format, with a maximum of two signal layers and one schematic sheet. All other features correspond to those of the Professional Version. Download it from our Internet Site or order our free CD.

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CIRCLE 283 ON FREE INFORMATION CARD

TED NEEDLEMAN

COMPUTER BITS

PUTTING A SCANNER TO WORK

Those of you who have been reading **Popular Electronics** know that we've been exploring scanners for a couple of months in this column. We've talked about the technologies used in them, and some of the terms you'll run across when shopping for a scanner.

Last time, in particular, we took a look at a comprehensive scanning utility from ScanSoft called *Pagis 3.0* and walked through the process of performing a simple scan. For those of you who are new to this column or simply missed the last installment, *Pagis 3.0* features a drag-and-drop approach to scanning and includes image-editing and Optical Character Recognition (OCR) tools.

This time around, I'll introduce you to the latest iteration of a great inexpensive photo program, and we'll perform a couple of projects to give you a somewhat better idea of what's involved in using a scanner. None of this stuff is really difficult to accomplish, though, like any other task, the more you do it, the easier it becomes.

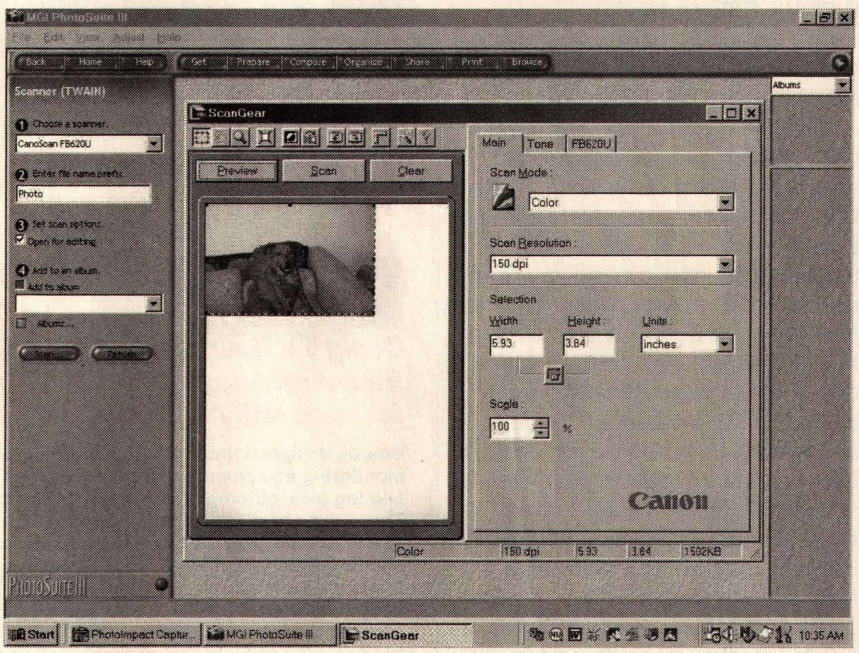


Fig. 1. Clicking on the Get button lets you launch the CanoScan's TWAIN driver.

USING THOSE PICS

The most frequent task that the scanners in this household get put to use for is scanning a picture. If this is being performed by one of my kids, the picture winds up being incorporated on the cover of a report for school, or as part of the report itself. Most of the time that I use a scanner, it's to take a photo, crop it, and blow it up as an enlargement.

A fun way, however, to use a scanner is to scan some photos and use them to create custom calendars. I generally like to tape a calendar for the current and upcoming months onto one of my whiteboards, so I can figure out when a particular article is due. I do try and keep track of deadlines and appointments using a PIM (personal information manager) on my PC, but a calendar gives me a good overview at a glance.

So, to demonstrate how to put a scanner to work, we'll make a January 2K calendar, incorporating a picture of my favorite canine—Sparky the Wonder Dog. Sparky is my office guard dog and faithful companion, so he's a great subject to place in my calendar. Of course, other months would have the rest of my family—the wife and kids.

STEP BY STEP

For this project, I turned to the newest version of an old favorite: *PhotoSuite III* from MGI Software. As with many packages of this genre, *PhotoSuite III* is a very easy-to-use image acquisition and editing package. It also comes with lots of project templates, so you can easily make calendars, magazine covers, and even sports trading cards.

Step one is to scan Sparky's photo. You can do this first, but *PhotoSuite III* also lets you do this from within its interface. By clicking on the Get button, you are offered a variety of choices of where to "get" an image from. If you have a digital camera, like the kinds used for videoconferencing, or just want to get the image from a file, you need to specify that here.

We'll choose the CanoScan FB620U (the scanner connected to our system), which will launch Canon's TWAIN driver. This setting panel appears to the left of the main window, and we can set the image type (photo), and click the Scan button to accept the default scan resolution. This, in turn, brings up the

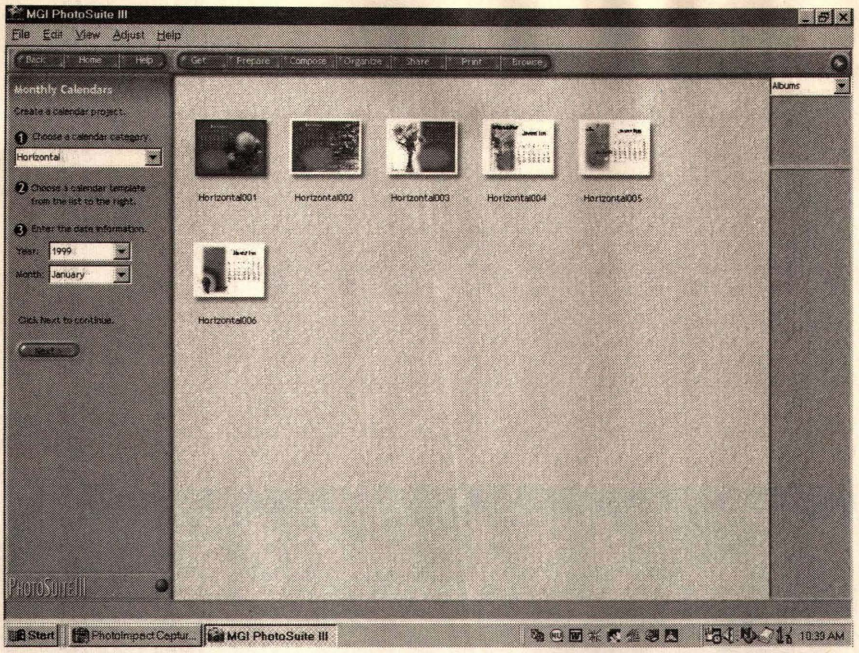


Fig. 2. After you've scanned and cropped an image, select a project template to use it with.

VENDOR INFORMATION

Canon USA, Inc.
1 Canon Plaza
New Hyde Park, NY 11042
800-OK-CANON
www.canon.com
CIRCLE 100 ON FREE INFORMATION CARD

MGI Software Corp.
50 West Pearce Street
Richmond Hill, Ontario
Canada L4B 1E3
888-MGI-SOFT
www.mgisoft.com
CIRCLE 101 ON FREE INFORMATION CARD

ScanSoft Inc.
9 Centennial Drive
Peabody, MA 01960
978-977-2000
www.scansoft.com
CIRCLE 102 ON FREE INFORMATION CARD

ScanGear scan utility window, where we can preview the scan, make any other desired adjustments, and perform the final scan. Figure 1 shows what this screen looks like.

Once the scan has finished, you are presented with the *PhotoSuite III* editing window. Since I want Sparky in the calendar, but much of the photo we scanned also includes the couch, we'll use the cropping tool to crop out pretty much everything but the dog. Just to be careful, we'll save the new image as a separate JPEG file, using the Save As selection under the File menu.

Now it's time to use the image. *PhotoSuite III* offers hundreds of different templates into which you can place your image(s). Clicking on the Compose bar brings up a choice of different projects, and if you choose Calendars, you'll first be asked what format (horizontal or vertical) you want, what frequency (yearly, monthly, weekly, *etc.*), and then be presented with a selection of different styles or templates (Fig. 2). We'll select the one with an apple on the right hand side of the calendar. By clicking on the subject, we can then delete the current image (the apple), and insert the image we want (Sparky).

The calendar took less than 10 minutes to make, including the process of scanning the photo. Check out the finished product in Fig. 3.

Once we have the image we want, however, we don't have to stop there. After saving and printing our calendar, we can return to the Compose menu, and select another project style, such as a magazine cover. A few more mouse clicks, and Sparky can be immortalized on the cover of a mockup "Pets" magazine!

Keep in mind that MGI's *PhotoSuite III* isn't the only software to offer this type of easy project. Many of the scanners available these days include similar applications, which also have lots of easy-to-do projects, and provide easy image editing (as does MGI's package) to let you get rid of red-eye in photos, or adjust colors that are a bit off. But if you do need a package that's a shade better than the one that came with your scanner, *PhotoSuite III* is a great value at just under $50.

That's about it for this time. Next month, I'll show you how to set up a simple network without running cables. And you won't even have to open up your PC to do it. And, as always, I welcome your comments. You can e-mail me at *tneedleman@aol.com*.

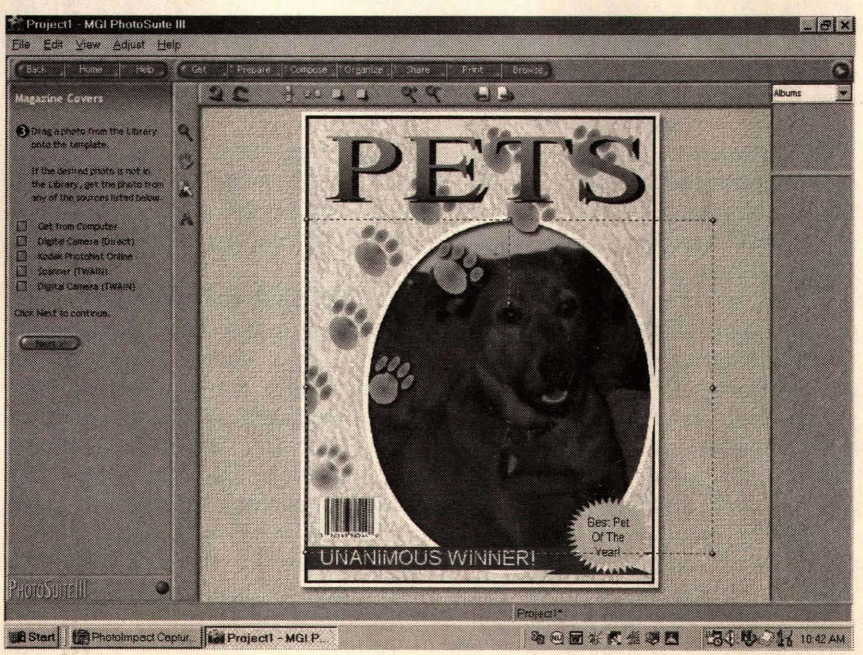


Fig. 3. Here's Sparky on the cover of a mockup pet magazine.

KONSTANTINOS KARAGIANNIS

NET WATCH

Free Web Access Options

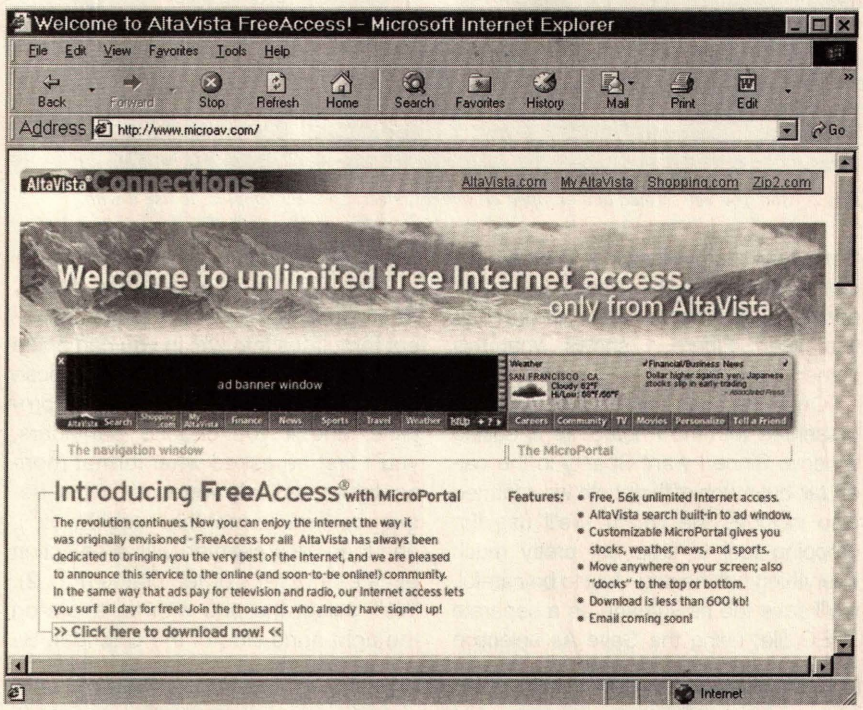
About half a year ago in **Popular Electronics**, we covered a free Internet Service Provider (ISP), expecting that more than a few of our readers would be interested in getting online for nada. However, we didn't expect the deluge of letters that followed the issue. Apparently, the company we covered, NetZero, got rid of its 800 number, resulting in unfortunate confusion we couldn't prevent.

Realizing that plenty of you would still like to get free Internet access, we decided to revisit NetZero as well as cover a new free ISP in this first issue of **Poptronics**. So read on and get ready to stop writing those $20 checks every month.

HOW?

Advertising makes the media world go round. You no doubt know this just from watching broadcast television. Beer commercials generate revenue for the NFL, jean commercials are found in just about every teen show on the airwaves, and Saturday morning cartoon shows feature enough toy ads to send children into hysterics over the latest action figure or doll. Besides providing breaks for a bathroom visit or refrigerator raid, commercials pay the millions necessary for keeping broadcast TV free. That's right ... ads pay so you don't have to.

Since the Internet is now competing with TV, and more of us are spending time online, the Net has quickly become a target for advertisers. Whether they're promoting Web sites or real-world stores and services, advertisers see the "ratings" of the online world as valuable. That is, valuable enough to warrant paying big bucks for—big enough bucks to make the Net free of monthly fees.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Internet

Check out AltaVista's FreeAccess site, download a small program, and never pay for Web access again.

The providers we look at this month use targeted advertising to ensure that the best penetration per dollar is made into Internet households. To use either AltaVista FreeAccess or NetZero, you will have to complete a profile that records your various interests and specific demographic data. In many ways this beats TV advertising, where you may be forced to watch ads that are of absolutely no interest to you.

After you dial into your free ISP of choice's local number, your e-mail client and Web browser programs will always share screen space with a small advertising window. The latter will be on top of the Net programs and impossible to hide, but it is small enough to position in a screen corner without biting into too much of your screen real estate. Of the two ISPs, AltaVista's popup window is actually useful. We'll explain why in a moment.

ALTAVISTA EXPANDS

If you've been online before, then chances are you've come across AltaVista.com. It's a wonderful and innovative search site that features not only a Web and Usenet query engine and customizable start page, but online language translation as well. Like many other sites, AltaVista provides access to Web-based e-mail. Now the site's gone a step further in its offerings.

While its e-mail is still only accessed through a browser,

HOT SITES

AltaVista FreeAccess
www.microav.com

NetZero
www.netzero.net

FreeAccess now has free dial-up access to the Web itself. Covering practically every area code, the numbers ensure you can get online from almost anywhere in the US (as with any access number make sure the exchange, or first three digits after the area code, is billed as a flat-rate and not a toll call).

To get started with the FreeAccess service, you need to download a small (600K) application that works with Microsoft's Internet Explorer 4.0 (or higher) for Windows 95 or 98. Interestingly enough, you can use any browser to actually surf the Web, but IE must be installed on the system.

System requirements are minimal. Your PC needs to be a 486 or better with 16MB of RAM and have a 14.4 Kbps or faster modem (the dial-up numbers support 56 Kbps).

After you run the installation program, FreeAccess will present you with a chance to choose your dial-up location and username and password. Then, after completing a short questionnaire, you're ready to go online.

The ad window that appears with AltaVista FreeAccess contains some nice extras. On the bottom are located search buttons that make finding Web sites a breeze. To the right is a handy area called MicroPortal, where you can get custom information such as local weather, sports, and news headlines. It's amazing how fast you get used to having this floating window on your Windows Desktop. Best of all, the higher your screen's resolution setting (1024 × 768, for instance), the smaller the ad window will appear.

The only real drawback to AltaVista FreeAccess at the time of this writing is that you have to be online to download the requisite software. Of course, at 600K the program will fit on a floppy, making it simple enough to ask a friend to snatch it off the Web for you.

NETZERO REDUX

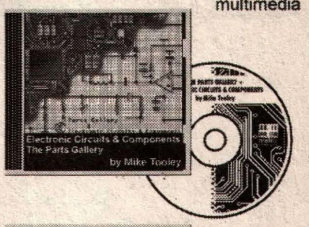
NetZero is another free provider with a software package you'll need to obtain. However, this program, called

Electronics CD ROMs

produced by: matrix multimedia

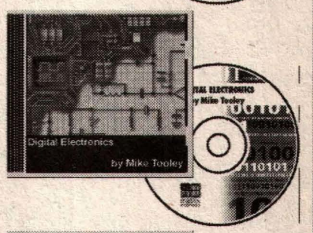
Want to improve your design skills?

Then you should consider our range of CD ROMs by best-selling author **Mike Tooley**.



Electronic Circuits and Components provides a sound introduction to the principles and applications of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analog circuits and digital circuits. Includes circuit s and assignments for Electronics Workbench.

The Parts Gallery has been designed to overcome the problem of component and symbol recognition. The CD ROM will help students recognize common electronic components and their corresponding symbols in circuit diagrams. Quizzes are included. The Parts Gallery is free with Electronic Circuits and Components.



Digital Electronics details the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers, and displays. The CD ROM also provides an introduction to microprocessor-based systems. Includes circuit s and assignments for Electronics Workbench.

Analog Electronics is a complete learning resource for this most difficult subject. The CD ROM includes the usual wealth of virtual laboratories as well as an electronic circuit simulator with over 50 pre-designed analog circuits, which gives you the ultimate learning tool. The CD ROM provides comprehensive coverage of analog fundamentals, transistor circuit design, op-amps, filters, oscillators, and other analog systems.

"...hammers home the concepts in a way that no textbook ever could."
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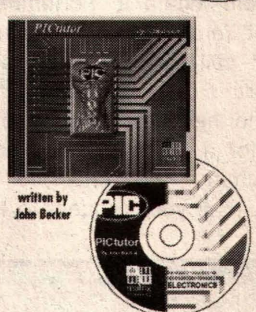
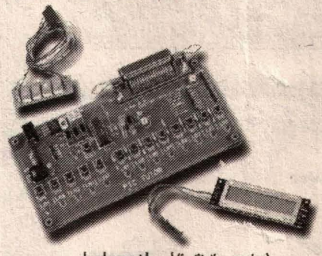


Our PICtutor CD ROM can teach you how to write assembly language programs for the PIC series of microcontrollers. The CD ROM's 39 tutorial sections will guide you from basic PIC architecture, commands, and programming techniques up to advanced concepts such as watchdog timers, interrupts, sleep modes, and EEPROM data memory use. Over 80 exercises and challenges are provided to test your understanding, and the unique Virtual PIC allows you to write and test programs on-screen.

The complementary development kit includes a reprogrammable PIC16C84, which you can program via your printer port. The institution version (designed for use in schools, colleges and industry) includes a quad 7-segment LED display and alphanumeric LCD display. The development kit provides an excellent platform for both learning PIC programming and for further project/development work. Assembler and send (via printer port) software is included on the CD ROM.



development board (institution version)

Prices and Versions

Institution versions are suitable for use in schools, colleges and industry. Student versions are for student/home use.

	student version	institution version
Electronic Circuits & Components	$56	$159
Digital Electronics	$75	$189
Analog Electronics	$75	$189
PICtutor (CD and development board)	$179	$350

Shipping costs to Canada an additional $5. Overseas orders please contact CLAGGK Inc. for shipping costs.

see http://www.MatrixMultimedia.co.uk for full specs and demos

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Please circle the products you would like to buy on the table above right, calculate the total cost, fill in the form below and send it to us. Please allow 4 - 6 weeks for delivery.

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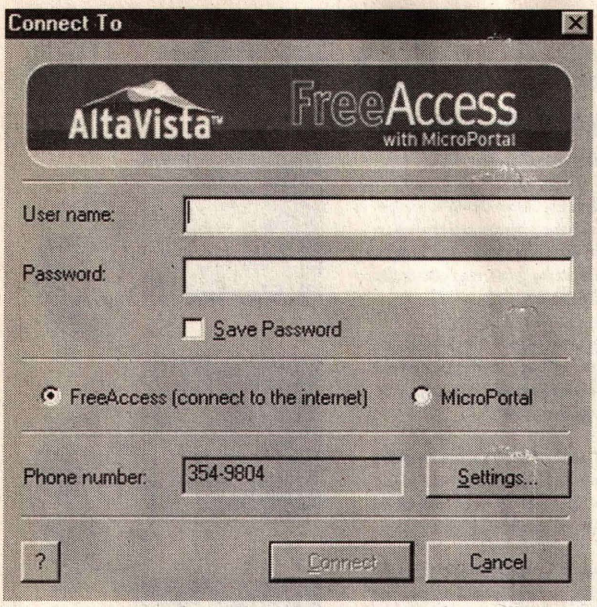


Once you choose your local phone number and fill out a brief questionnaire, FreeAccess lets you log on as you would with any other dialer. Enter your username and password, and it's off to the Web.

ZeroPort, is a lot larger than that of FreeAccess, requiring five floppy disks to accommodate it. Fortunately, you can get *ZeroPort* without downloading it. Just call 888-279-8132 (available 24/7) with a credit card handy. NetZero will send the dialer software to you on a CD for a $6.95 shipping and handling charge. For check or money orders, mail your request to NetZero Inc., Attn: CD Orders, PO Box 3009, Thousand Oaks, CA 91359. Include your first and last name, address, city, state, zip code, and phone number (per NetZero's request). It takes about two weeks to get the disc.

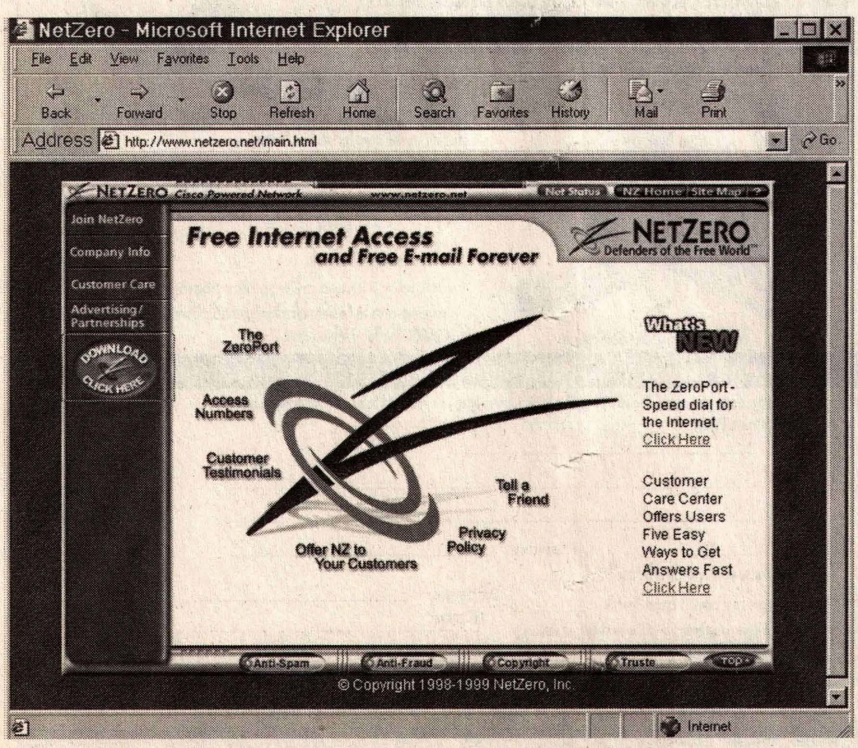
When you run *ZeroPort*, it will ask for your area code to help you choose the dialup number closest to you. We found one right in the town that our office is located in, but again, do check with the phone company to see if the exchange of the number makes the number you find a local call.

You will then choose a username and password. Your e-mail account will, as a result, be automatically created as *yourusername@netzero.net*. A step ahead of FreeAccess in this respect, NetZero lets you use a standard e-mail client like *Outlook* or *Eudora* to access your e-mail.

Like FreeAccess, prepare to fill in some personal details in a questionnaire. Fortunately, it's quick and painless.

Each time you log on, you'll be presented with the AdVantage Window, which measures about 1 by 3 inches on an 800 × 600 display. The 30-second ads that AdVantage displays are not only targeted, but intelligent in relation to what site you're visiting. Visit a book site, for example, and an offer from a company like Amazon.com may appear.

That's all the space we have this month. Here's hoping that NetZero or AltaVista meets your online needs. Feel free to send us any questions or comments via snail-mail to *Net Watch*, **Poptronics**, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mail to *netwatch@gernsback.com*. P



NetZero offers full access to the Web and standard e-mail for free. Download the free dialer or order it on a CD to get started.

SYSTEM DESIGN

(continued from page 42)

OUT OF THE ORDINARY

Although the small size of the Vaio Slimtop limits its expandability to a large extent, it is not as limiting to the system's usability as you might guess. The reason for this is that Sony provided a number of alternative ways to hook up peripherals to the Slimtop. In addition to a pair of USB ports—probably one of the easiest ways to add a scanner, printer, or other peripheral—there is a Type II PC Card slot. You can use this slot for memory cards,

SPECIFICATIONS

Model: Vaio Slimtop PCV-L620
Price (as configured): $2299
Vendor: Sony Electronics, Inc., 3300 Zanker Rd., San Jose, CA 95134; 888-315-7669; *www.sony.com*
CPU: 500-MHz Intel Pentium III
Memory: 128MB SDRAM, expandable to 256MB
Storage: 10GB Ultra ATA/66 hard disk, 1.44MB floppy disk
ROM Drive: 6X DVD
Video: 14.1-Inch LCD panel, ATI RAGE LT PRO with 4MB RAM
Audio: Yamaha YMF-724 wavetable chipset, stereo speakers built into monitor
Size: 3.5 × 11 × 13.25 inches (HWD)
Ports: Parallel, serial, VGA, two USB, IEEE 1394
Expansion: One PCI slot, Type II PC Card slot, Sony Memory Stick slot
Other: Windows 98, software bundle

CIRCLE 120 ON FREE INFORMATION CARD

network interface adapters, or even external hard disk and tape drives. Also provided is a Memory Stick slot. This is a new rewriteable memory media introduced by Sony last year. And while it has not yet been embraced by large numbers of peripheral vendors, the technology is used by Sony in its own consumer devices, such as digital cameras and an MP3 player. Sony hopes for more general acceptance, but as with all new storage media, only time will tell.

There's one additional feature of the Sony Vaio Slimtop we liked very much: an IEEE 1394 port. Sony calls this an iLink port, while others sometimes call it a FireWire port (though "FireWire" is actually an Apple trademark). Regardless of the appellation you use, it can provide a high-speed link between two systems or make it a snap to transfer digital video between the Slimtop and a digital camcorder. Sony also includes a very comprehensive software bundle, which has applications for both digital still and digital video editing.

This interesting design doesn't come cheap. At the same time, the Sony VAIO Slimtop is not really much more expensive than any other premium brand name 500-MHz Pentium III desktop with an LCD monitor. And it looks much better than most of the competition's more conventional designs. P

COMPUTER SECURITY

(continued from page 50)

Rather than block out such programs and thereby make the host Web sites look dull, the eSafe Protect Desktop in *Best Defense* traps these mini programs in a safe area called a "sandbox." This way, Java and ActiveX apps can run and offer you all the excitement of a cutting-edge Web experience, yet if any of them try any funny stuff your system will be kept safe.

Perhaps you've heard of "cookies"? They're files kept on your system that store personal information to identify you to certain Web sites, for example, a username and password to let you enter the *New York Times Online* without typing authentication. However, sometimes really personal information like your phone number or even credit card number (!) can end up in these files. The last thing you'd want is for a site you visit to capture such data. The Personal Firewall feature of *Best Defense* prevents any of this info from being given out. The Firewall even keeps hackers from actively trying to penetrate your system while you're online.

Another great feature we touched on just a couple of paragraphs ago is the program's ability to protect from certain types of in-person tampering. If you're afraid of your kids or coworkers messing up your computer's settings, use *Best Defense* to customize your Start menu. If anyone other than you tries to change a system setting or run a program you don't want run, the system will not allow it. After all, some of the biggest threats to a computer can be from a person who just doesn't know any better.

Keep in mind with either of the aforementioned suites that as far as virus protection goes, it's only as good as your latest anti-virus update. You'll need to regularly download virus-identification tables that the software will use to check for the latest online threats being discovered. Should a new one come out between downloaded updates and your machine catches it, well....

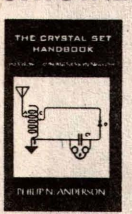
However, there is a way to guarantee that a virus, no matter how new, can never *ever* affect your system. Though it costs a bit more, Calluna's *PC Bodyguard* ($199) provides a unique approach to warding off those nasty little technodemons.

Rather than rely on virus tables, Bodyguard uses a special ISA card to protect your system. Once the card is inserted, you run a cable (included) that lets the card act as a go-between, stepping in between your hard drive and motherboard. The card has its own microprocessor, which cannot be affected by any kind of virus. This chip vigilantly watches over all access and write attempts made to your hard drive. Further, it sets up "hard walls" or protected areas on your hard disk. Should any virus attempt to destroy your data, not only will it likely be stopped immediately, but its attempts will only be made within a particular area. In other words, none of your precious data outside the active area will even begin to be affected.

Note that protected areas can be set up to allow access only to certain users. This keeps hackers or other invaders from being able to affect, say, the boot sector or operating system. Further, thanks to Write Many Recoverable (WMR) technology, PC Bodyguard can recover from any damage made to the primary boot partition. If, somehow, a virus did try to change something in this critical section, all you would have to do is reboot your machine. This is because Bodyguard only allows changes to be made to a separate "scratch" area that is wiped on power-down. As a result, no real damage can be done by either confused users or those attempting genuine malice.

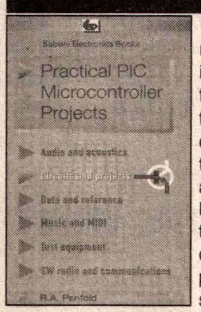
The folks at Calluna have come up with a real winner for the security-conscious. As long as you have a Pentium PC or better with a CD-ROM, running Windows 95/98/NT, you're set. Of course, your machine must have an open ISA slot for the card. Ω

Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only **$10.95** plus **$4.00** for shipping and handling. **Claggk Inc., P.O. Box 4099, Farmingdale, NY 11735.** USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

Practical PIC Microcontroller Projects



This book covers a wide range of PIC based projects, including such things as digitally controlled power supplies, transistor checkers, a simple capacitance meter, reaction tester, digital dice, digital locks, a stereo audio level meter, and MIDI pedals for use with electronic music systems. In most cases the circuits are very simple and they are easily constructed. Full component lists and software listings are provided. For more information about PICs we suggest you take a look at BP394 -- An Introduction to PIC Microcontrollers.

To order Book #BP444 send $7.99 plus $3.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery. ET10

NEW LITERATURE

Digital Home Recording

Edited by Carolyn Keating and Craig Anderton
Miller Freeman Books
6600 Silacci Way
Gilroy, CA 95020
Tel: 800-848-5594 or 408-848-5296
Web: www.books.mfi.com
$19.95

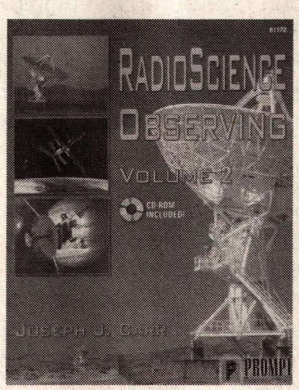
With the cost of CD-R drives plummeting, the process of making audio CDs can easily be shifted from the professional to the home studio. This practical, all-in-one guide is packed with how-to instructions plus tips and techniques for creating and operating a cost-effective digital recording studio at home, by choosing and using the right digital recorder gear, hardware, and software.

Beginning with the fundamentals of sound and the nature of digital audio, the book goes on to expert tricks for studio setup and maintenance, selecting and protecting equipment, recording, mixing, burning, and troubleshooting. Hands-on instructions present the home recording potentials of digital audio tape (DAT), CD-R, MIDI, samplers, sound cards, and more.

Radio Science Observing, Volume 2

by Jospeh J. Carr
Prompt Publications
Howard W. Sams & Company
2647 Waterfront Parkway, East Drive
Indianapolis, IN 46214-2041
Tel: 800-428-7267
Web: www.hwsams.com
$34.95

In this expanded edition, there is all new material covering techniques and methods, hardware design and construction, and more RadioScience theory. In response to readers of the previous edition, related geo-science and planetary scientific activities have been added. The included CD-ROM contains information for making calculations, in addition to audio clips.



Subjects covered include propagation anomalies, electromagnetic fields and safety, finding compass bearings, seismic observations, receiver selection, and radio telemetry on a budget. There is also a chapter written by Dr. Paul Shuch of the SETI League.

HTML 4.0 Specification

toExcel
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Lincoln, NE 68504
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Web: www.toExcel.com
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This book contains the complete text of the latest available version of the HTML 4.0 specifications and reference manual. It s designed to be a handy desktop companion for HTML Web page authors, Internet program developers, information technology managers, and anyone else who publishes documents on the Web. It provides full detail on all

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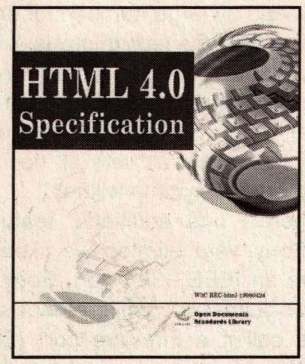
Free catalogs are *not* available.



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Digital Logic Gates and Flip-Flops

by Ian R. Sinclair
Electronic Technology Today
P.O. Box 240
Massapequa Park, NY 11762
$14.99 (including S&H)

Gates and flip-flops are the building bricks of all digital electronics, and the knowledge of how to carry out logic actions with gates and flip-flops is needed more than ever. Intended for enthusiasts, students, and technicians, this book establishes a firm foundation in digital electronics by starting from the beginning and treating the topics of gates and flip-flops thoroughly. It is meant for the user who wants to design and troubleshoot digital circuitry based on a thorough understanding of the principles.

Topics such as Boolean Algebra and Karnaugh mapping are explained and more attention is paid to synchronous counters than to less important ripple counters. Also an explanation of microprocessor techniques as applied to digital logic. P

ProService Magazine

January, 2000

NESDA's 50th Year

An official journal of NESDA (National Electronics Service Dealers Association), and ISCET (International Society of Certified Electronics Technicians).

VOL. XXVI, NO. 1

PURPOSE

ProService Magazine, included in each issue of ***Poptronics,*** is produced by NESDA, the National Electronics Service Dealers Association, 2708 West Berry St., Fort Worth, TX 76109. It is intended for the enlightenment, education and entertainment of the members of NESDA, ISCET, and other ethical professionals engaged in or connected with the appliance, computer, and electronics service industries.

With the exception of official announcements, the statements and opinions expressed herein are those of the authors and not necessarily those of the associations.

Unless otherwise clearly indicated, neither NESDA nor ISCET endorses any company, product or service appearing in any article in this publication.

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NESDA Helps With Service Center Survival

NESDA has a history of service to its members, including education, technical and management training, and discounted business services. It also provides legislative representation on a national level. Independent product servicers *need* that kind of support from an association.

by Mary Margaret Merrill

If you're looking for a trade association for professionals in the business of repairing consumer electronic equipment, appliances, or computers, look no further. The face of The National Electronics Service Dealers Association (NESDA) has changed since its inception in 1950, and membership has grown. But, it is still a group of dedicated professionals that contribute to the betterment of the service industry.

Founded on a strict code of ethics, NESDA's primary goal has been to help members become more profitable in the face of escalating business demands. To that end, management and technical seminars are presented annually to help members keep pace with advancing technology. In addition to business management and technical expertise, training sessions teach participants to recognize and meet the changing needs of discriminating consumers. Through volunteer activities, membership fees are kept to a minimum to allow participation by interested small business owners.

As an organization, NESDA also helps members contend with the increasingly costly requirements of governmental bureaucracies. Concerned members police current national legislation so that the association can challenge proposals detrimental to independent servicers.

THE MEMBERSHIP

Collectively, NESDA members provide service on all types of electronic equipment. Most fall under the categories of consumer products (including radios, televisions, and video equipment). Other categories include appliances, antenna and satellite receiving equipment, computers, communications products, bio-medical, industrial electronics equipment, and more. Business sizes vary from the small one-person shop to the large multi-personnel, multi-location establishments.

THE BENEFITS

NESDA provides a number of programs to benefit its members. New programs are added on an ongoing basis, while programs that are in place are honed to make them more productive. NESDA currently offers:

- **Code of Ethics:** This is a collective membership effort at self-policing, and to help assure the consuming public of competent and ethical service.
- **Website Referrals:** The NESDA website (www.nesda.com) is where consumers seeking competent service can search for NESDA members by zip code. Updated information about NESDA and the service industry is available to non-members, as well as a special section "for members only."
- **NESDAnet Email Network:** A development which allows members to contact all other participating members, forming a vast information network. Queries allow participants to solve tough technical questions through the specialized knowledge of other participants, report on industry problems, or comment on professional concerns. It is, literally, information at your fingertips.

(continued on PS-2)

(NESDA Helps, continued)

- **Annual Convention & Trade Show:** The National Professional Service Convention is a week-long fun and learning experience. It presents top-notch technical and business management seminars; an electronics instructors conference; special servicer meetings with manufacturers, service contract administrators, and other services suppliers; one-on-one communications with key manufacturers' service executives; a service-oriented trade show; member-to-member networking and information-sharing; association meetings and officer elections; sponsored meal functions; sports and fun events; hospitality sessions; and a tax-deductible vacation for service professionals.
- **Technical & Managerial Certification:** NESDA provides study materials and testing for managers who wish to improve their professional expertise and become a "Certified Service Manager" (CSM). Through NESDA's technical arm, the International Society of Certified Electronics Technicians (ISCET), technicians may also measure their professional abilities through the "ISCET-Certified Electronics Technician" program.
- **Liaison with Manufacturers & Service Providers:** Members' concerns and unresolved problems are relayed to high-level representatives of companies and groups that affect the product service industry. Mutually rewarding relationships are cultivated, making things better for servicers, and earning respect from other segments of the industry.
- **Universal Authorized Service Center Agreement:** NESDA officers and staff work for fairness and uniformity in the administration and application of manufacturers' and service contract companies' rules for authorized servicers. This includes the development of a "universal" agreement that is designed to clarify and standardize the contract clauses between manufacturers and service centers. Member dealers can compare a manufacturers' agreement with this "standard" for the purposes of informed negotiation.
- **Professional Aids, Supplies, & Public Relations Materials:** Members receive discounts on books, educational videotapes, business aids, computer software, promotional materials, training sessions, and more. Consumer pamphlets explain servicing concerns, service guar-

(continued on PS-3)

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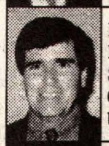

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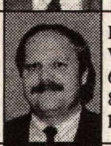

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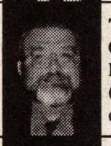

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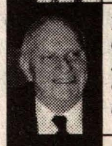

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NESDA REPRESENTATIVE: Jack Hopson CET/CSM, First Electronics Service, 5214 Center St., Omaha NE 68106; 402-551-4868; jack@1sttv.com

Also includes ISCET C.E.O. or Designate: Alice Brown, Dir. Member Services

NESDA's Code of Ethics

- I will conduct my business in a manner to insure the goodwill and confidence of the public that I serve.
- I will not participate in any misleading or false advertising.
- I will maintain adequate equipment and qualified personnel to perform quality service to the public and the trade for fair, equitable and nondiscriminatory charges.
- I will not perform, or cause to be performed, any act which would tend to reflect adversely on our industry, fellow members, competitors or manufacturers.
- I will comply, both in spirit and letter, with rules and regulations prescribed by the law and by government agencies for the health, safety and well-being of my employees and the public.
- I will maintain liability and financial responsibility in order to uphold the guarantee for all work undertaken.
- I will represent manufacturers in an honest and intelligent manner to create an atmosphere of mutual trust and understanding and to best serve our combined interests.
- I will offer clean, attractive and inviting facilities, as well as courteous and competent personnel.
- Accurate statements or invoices will be rendered to the customers and a comprehensive record of all work will be kept. I will readily explain and justify all prices.
- All complaints will be promptly and courteously handled.
- The property of all customers will be carefully handled and adequate insurance will be carried to protect this property while in my custody.
- I will seek always to improve myself, to increase my efficiency and to better my services.
- I will perform only such work as is needed and authorized by the customer, and all parts will be new and first quality unless otherwise specified.
- I will work with the community to improve the public perception of my company and the electronics service industry, to better the community and to improve understanding between these entities.
- I will aid the industry's growth and progress by participating in the activities and public interest efforts of the association.

This strict code of business ethics should be adhered to by every service dealer, but is adopted as a criteria of membership by every person who joins NESDA.

(NESDA Helps, continued)

antees, extended warranties, and how to select a competent and ethical service company. Also available are membership wall certificates, wallet cards, stick-on decals, lapel pins, door signs, advertising art, etc., that proclaim affiliation with a national network of ethical servicers.

- **Bankcard Program:** Members receive low bank card discount rates.
- **Group Insurance:** Combined buying power provides the coverage servicers need at true group rates on life, health, accident, disability, business, and workers' compensation.
- **Business Forms:** Substantial discounts are offered on universal, manufacturer-accepted invoice for in- and out-of-warranty service billing, and other forms needed by servicers.
- **Discounted Long Distance Service:** Through the NESDAfone plan, most members can receive a discounted, hard-to-beat long distance rate (currently at 6.9 cents per minute).
- **"PRIDE" Business Certification Program:** Provides authentication of those service centers that provide certifiable proof of their excellence in offering prompt, competent, ethical, and guaranteed service to consumers and clients.
- **FREE Magazine Subscription:** *ProService Magazine* is now included in *Poptronics* magazine. Articles are presented on a variety of educational and informational topics of concern to independent servicers, such as business management, tax tips, insurance information, a calendar of industry events, association news, and more. Members receive a free subscription to *Poptronics* with their paid membership.
- **ProService Directory/Yearbook:** An annual directory of useful information containing names, addresses, and contact numbers for key personnel at manufacturers, national parts distributors, service contract vendors/administrators, educational sources, other national trade associations, trade publications, state associations, and key service people, as well as pertinent association information.
- **Periodic Newsletters:** In addition to *ProService Magazine*, members receive informative newsletters throughout the year. The *NESDA Newsletter* carries association news, board actions, officer reports, staff activity, new benefits and programs, letters, and other information.
- **Self-Expression on Issues:** Members have the opportunity to speak up on industry matters or other topics of concern in the newsletters or magazine, at the annual membership meeting, or on the NESDAnet.
- **Information:** NESDA headquarters is your central location for receiving questions from members, searching for answers, and relaying information.
- **Legislative Vigilance:** Members are advised of federal legislative activity that effects the service industry. Congressional representatives or applicable courts are lobbied on behalf of the service industry.
- **Special "Alert" Mailings:** A *"Legislative Alert,"* when needed, informs or warns members of Congressional acts, or impending legislation that may require action. A periodic *"Informational Alert"* advises of other industry events that members may need to know of quickly.
- **A Technicians' Division:** ISCET is the technical division just for professional technicians who have passed the ISCET-Certified Electronics or Appliance Technician exam.

NESDA invites you to join its success, and the success of its members, by actively participating in these programs, as well as those still in development. Together we form a better, more knowledgeable service industry, and help to assure the future of independent service.§

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NEW GEAR

(continued from page 72)

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The TR-20 and TR-21 Global Digital Video Converter have suggested retail prices of $729 and $799, respectively.

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The GrandMaster Power Meters have prices ranging from $94.95 to $169.95

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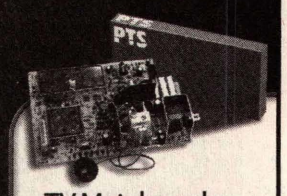

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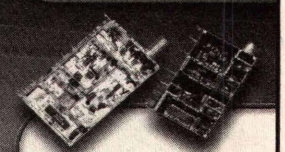

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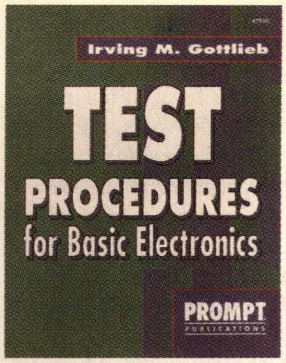

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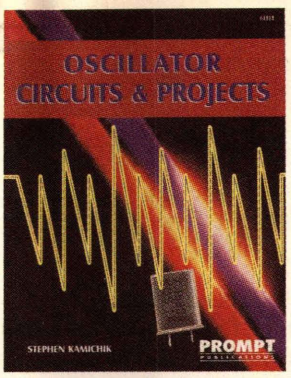

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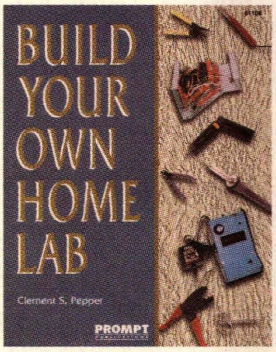

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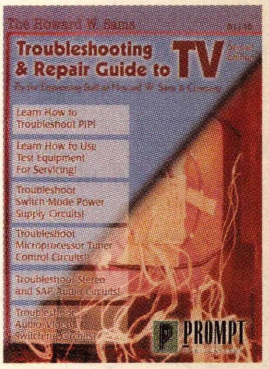
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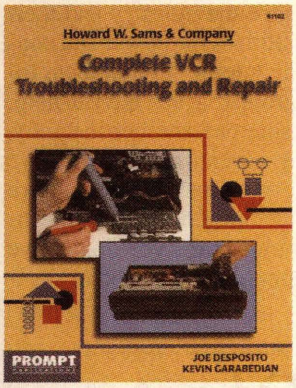

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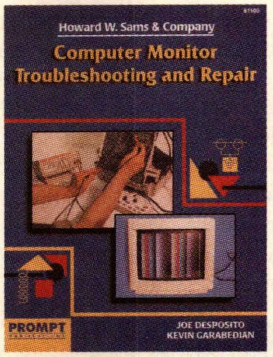

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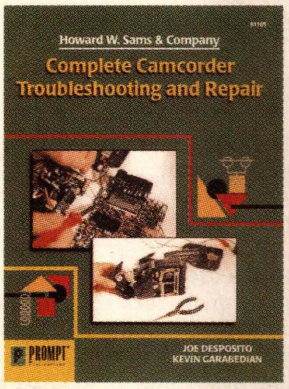

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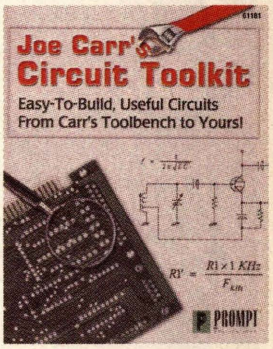

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NESDANet: A Tool For Success in the Product Service Business

If you want your business to *grow* and prosper, you can't go it totally alone. One of the best "tools" is a collection of your peers who will help you find parts, advise you about equipment, critique your business, and tell you what will and won't work profitably. And, it's available any time you want access to it.

by William S. Warren CET/CSM

Success in the service business: that is the goal we all had when we first opened our service center doors. No one starts out to fail in business, but unfortunately, many do. And in the coming years, an increasing number of servicers will have to close their doors, and shatter their dreams.

There was a time when almost anyone could succeed in consumer electronic service, to a certain degree, based on technical ability alone. Unfortunately, the economics of the business environment today leaves too little room for error. In the past, there were plenty of customers to go around, and profits were sufficient to cover up some inefficiencies. Nowadays, however, customers are more scarce and profits are thin. Inefficiencies cannot be tolerated. To be successful, the servicer of today and tomorrow must take advantage of all the tools available that can help him or her reach their goals.

There are numerous aids available to managers seeking to grow their businesses. There are books, video tapes, and hands-on seminars that can help their technicians become more proficient, or classes to help managers master management principles. There are software programs that help with store layout, inventory control, parts and labor pricing, routing, debt collection, warranty payments, and almost any other facet of business.

But, over the past 50 years, the single most important step any manager can take to successful entrepreneurship has been — and remains — membership in an effective trade association. And, for the past 50 years, the most effective trade association has been NESDA, the National Electronics Service Dealers Association.

NESDA offers many, many advantages to any product service business. You can read about some of them elsewhere in this magazine. But of all the benefits of NESDA membership, one of the most important to *me* is access to NESDA's internet-based information-sharing forum, NESDAnet.

NESDAnet is a nationwide group of servicers who have joined together to share information and experiences to collectively advance the industry and their businesses. It utilizes the power and convenience of the internet to link them together into a group that can advise, help, and even console one another instantly, 24 hours a day, seven days a week.

Need information on an obscure brand? Need technical help on an unusual problem or on a brand you don't have access to factory help on? Need to know

(continued on PS-5)

Where can you go to ...

- Hear industry news as it happens
- Request advice on specific needs from other servicers
- Locate hard-to-find parts
- Solve problems together
- Expose unfair business practices
- Receive NESDA and association news
- Help formulate industry standards
- Share unpublished warranty policies
- Participate in roundtable discussions

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the Professional Servicers' E-Mail Network

What is it?
NESDAnet is a group of astute professionals working together to improve their service businesses.

How does it work?
Electronic messages (e-mail) are sent via the Internet to the NESDAnet computer. The NESDAnet computer system then forwards the message to other users.

Who can join?
Any independent servicer who is also a member of NESDA is welcome. The current membership also includes NESDA headquarters, NESDA board of directors, manufacturers, field service reps, service contract companies, warranty claims processors, parts suppliers, national trade organizations, and association editors.

With* NESDAnet, *you are never "the only one."

What is needed to participate?
Membership in NESDA, a computer, a modem, and a subscription to any Email account.

What is the cost?
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— Business Management —

Going Beyond the "Cost of Doing Business" Analysis

Too many service dealers don't know their actual costs of doing business, but of those who *do* know, too many are using the information in the wrong way.

by Fred Longworth, M.B.A.

Sam came back from the cost-of-doing-business (CODB) seminar eager to revamp his prices. After a few calculations, it became clear that his flat rate of $79 labor plus parts to fix a VCR or TV was grossly inadequate. He really needed to charge $140 labor — just to break even!

Since he'd just opened his business, and the new phone book wouldn't be coming out until Spring, he was getting in only about 20 repairs a month. These were taking approximately 40 hours to complete.

His total monthly overhead came to $2,000. If he divided the $2,000 by the 40 hours which he had to sell, he got $50/hour — or $100 per 2-hour repair. To this he needed to add the direct cost of his own labor (treating himself as his own employee.) Since, at a bare minimum, he would have to spend $20/hour, including taxes, workers comp, etc., to replace himself, he figured his own cost at $40 per job. This upped the "breakeven point" to $140. Now, as a capitalist, he was entitled to a "businessman's profit," so he added another 10% for good measure ($14). The grand total came to a whopping $154 per repair.

He knew that a typical VCR or TV billed out at $25 or less in parts, so he put a big sign in his window: *"VCR/TV Repair — Fast 3-Day Service — Most Repairs Under $179 Including Parts and Labor."*

From that day on, except for an occasional big-screen TV, customer input dropped to zero.

When I met Sam at a trade association meeting, and he told me how slow things were, I said, "Why don't you lower your prices?"

He looked at me like I was crazy.

"I can't do that," he protested. "I'd lose money."

The problem is obvious: Sam has priced himself out of the market.

His customers won't pay $179 — or even $150 — for an ordinary VCR or TV repair. In Sam's town, you can get lots of business if you can profitably service garden-variety VCR's and TV's for $90 to $100. But, with the exception of high-end units, customers will go elsewhere — or just buy new equipment — when the repair price approaches $125.

In economic terms, the upper price limit for a repair is established by the marketplace. And the marketplace couldn't care less about Sam's arithmetic.

So, we need to ask: if CODB analysis doesn't define for us where, precisely, to set our price, just what does the analysis tell us? The answer is: it sets the lower price limit, the least amount we can charge and not go in the hole. But, we can't use this "breakeven" number to set our prices. We use it to compare against what we do charge, and thus, to calculate our margin, or our profit.

But, be careful. As we can surmise from Sam's example, CODB analysis gives us inflated numbers if the facility is operating below capacity.

In most cases, the highest profits are made when a product or service is sold at "what the market will bear." Luckily, there's a standard method for finding this out that provides us with real prices. And, curiously, to get a rigorous number and optimize your profits, you need to plug your CODB values into the formula.

Let me show you by example.

Assume that you currently charge $50 labor, plus an average of $10 in retail parts to fix a right-reverse whazzit. You call around in your town, pretend you are a consumer, and find that the competition has a spread of $55 to $75 labor, and an average of $10-20 in retail parts. Okay, now you know that you are the lowest price in a marketplace that generally runs $65 to $95 to provide the same service.

(continued on PS-6)

(NESDAnet, continued)

if a manufacturer will negotiate, even though the say they only offer flat rates? Thinking of expanding into a new product service category, but are unsure of the consequences and true costs? Or do you just need a little support to improve that developing tunnel vision, or give you that needed little push to do what you already know you should do?

In each of these cases, NESDAnet is the answer.

The beauty of NESDAnet is its ease of use. Members have the choice of addressing only fellow servicers for semi-private discussions, or the full NESDAnet family for a broader base of potential help. The "open" NESDAnet list includes manufacturers, parts distributors, and extended warranty administrators. There are additional lists that include other sub-groups, such as the NESDA and ISCET Boards of Directors.

While NESDAnet has its beauty, it also has its principle strength: the immediacy of the internet. It is not unusual for a member to post a request, and have a choice of replies within an hour or less. Strong and beautiful, what more can you ask for?

NESDAnet is *not* a social club, although it is a good place to make and maintain business friendships through ongoing discussions. It is *not* a forum for unchallenged complaints or grudges, but instead is a forum for discussions on policies and procedures that you find objectionable, as well as serious business issues facing servicers today. It is *not* a place for jokes or non-constructive dialog, although our members have been known to respond in humorous fashion. NESDA works diligently to keep NESDAnet a focused group on issues of concern to servicers. It may sound rigid but it isn't. It is member-driven, and our policies reflect the business-professionals who participate.

Participation is easy. You must be a regular member of NESDA, have a valid email address with both send and receive capabilities, and pay a modest fee of $60 per year. For more information on NESDA, how to join, or how to join NESDAnet, contact the NESDA national office at 2708 W. Berry St., Ft. Worth TX 76109-2397; 817-921-9061, Fax: 817-921-3741 or go on-line at: www.nesda.com. §

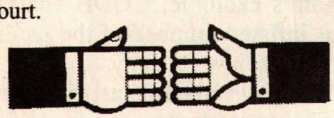
Editor's Note: *William S. Warren CET/CSM is the NESDAnet Director of Communications and owner of Warren Electronic Services in Knoxville, TN.*

Representing and Fighting for Independent Service

You Are Not ALONE!

NESDA is the national association dedicated to the plight and security of the independent service dealer — whether you service appliances, computers, consumer electronics, industrial electronics, MATV, biomedical instrumentation, TVRO, etc.

NESDA engages in fruitful dialogue and mutual cooperation with manufacturers who recognize and respect independents' rights. However, NESDA is also ready to fight unfriendly manufacturers and other monopolists in the halls of Congress or the chambers of the U.S. Supreme Court.



When You Join NESDA, You Get:

- Prestigious member identification material for door, wall and wallet
- Free subscription to every issue of *Poptronics,* which includes *ProService,* "news you can use" about the product service industry
- Free copy of the *"ProService Directory,"* 128-pages of service industry contacts
- Free members-only newsletters: "NESDA Newsletter," "Legislative Alert," special bulletins, and more
- Access to manufacturers' key service executives through NESDA's effective industry relations committee
- Access to headquarters staff for personalized advice or referral to authoritative source or knowledgeable members
- Access to the minds of other dealers — and other business experts — willing to share information freely
- Purchasing discounts for members on a variety of business aids, invoice forms, merchandise, and more
- Access to an annual convention and trade show with the industry's best and most cost-effective professional training
- National-level representation to government, manufacturers, etc. on important business and industry issues
- Much, much more *(for a full description of benefits and programs, return coupon)*

When You Join NESDA, You Get Help!

Isn't it time you joined the other professionals in electronics?

❑ *I want to find out more. Send information about NESDA, including an application.*

Name _____

Business _____

Address _____

City _____

State _____ Zip _____

Mail to NESDA, 2708 W. Berry St., Fort Worth TX 76109; 817-921-9061 or Fax to: 817.921.3741

— Business Opportunities —

NWSN: Service Companies That Would Service the World

If your service business is equipped to provide top quality service, and is willing to *guarantee* 'no unresolved customer complaints,' without exception, you may want to join the NESDA World Service Network. NWSN members feel they are preparing themselves for future business — and future success — now.

by Gerry McCann CET/CSM

When businesses join NESDA, they increase their abilities to function economically and profitably. And by becoming a small part of a greater entity, they also increase their ability to affect larger issues, such as politics and marketing. NESDA offers the strength of numbers to its members. More can be accomplished together than individually. Although NESDA offers a complete range of value-driven benefits for *all* members,

(continued on PS-8)

(Beyond CODB, continued)

Since you keep accurate records of the important categories of items you repair, you note that, typically, you service 25 right-reverse whazzits per month. That's a total of $60 x 25 = $1,500 revenue.

To earn this $1,500 revenue, your CODB analysis tells you that (forgetting the extra capitalist's kicker) you would need to charge an average of $45 ($40 labor, plus $5 wholesale cost of parts) to break even. This comes to $45 x 25 = $1,125. Subtract this from $1,500 and you get $375, which is your profit.

Now, you raise your retail price, say, to $60 labor and $10 in parts. You carefully note how this affects customer demand, and you find that demand drops to 24 units a month. That's okay, because your revenues are now $70 x 24 = $1,680. Your cost equals $45 x 24 = $1,080, and your profit is $600.

Flushed with success, you raise your retail price again, to $80. Now, you lose another couple of repairs — down to 22. But your revenues increase to $80 x 22 = $1,760. This generates a cost of $45 x 22 = $990, and a profit of $770.

Now, you up the retail price another $10 to $90. Input decreases to 18 units. Revenues go to $90 x 18 = $1,620. Cost drops to $810. Profit increases to $810.

Finally, you raise the retail price to $100. Input decreases to 13 machines. Revenues go to $1,300. Costs go to $585. Profit drops to $715.

Empirically, you have discovered a "maximum" (about $90) on the price/profit curve, a sweet spot above and below which profits decline. Generally, this price will be within the "spread" or range of other dealers' prices in your market, but occasionally it will be higher or lower. Regardless, you have discovered the point of highest return for a given category of set.

But, don't rest on your laurels. You should continue to monitor price vs. aggregate profit, category by category, always on the lookout for trends or sudden changes.

Now, some manufacturers still require you to provide a cost-of-doing-business analysis to justify your warranty rates. It is, after all, in their self-interest to pay you no more than they have to. And, unless you doctor the numbers — and many do — the analysis forces you to tip your hand. In some states, such as California, a manufacturer cannot, technically, pay you less than the CODB. (However, most will try, if you let them get away with it.)

This connection to warranty rate negotiations was, I believe, how the whole CODB obsession got going in the first place. But, you should know: in business school, a simple CODB pricing model is not encouraged. That's because it is assumed that you are trying to maximize your profits, rather than playing a pleasant little numbers game on paper.

In short: know what your costs of doing business are; don't be a slave to your findings. Use the information intelligently to ensure continued business — and profits. §

Editor's Note: *Fred Longworth CET, M.B.A. is owner of Longworth Consulting and StereoTech in San Diego, CA.*§

The Electronics Industry is looking for a lot of good people!

Here is your chance to get in on the ground floor as an Associate CET. Is your job title "Electronics Service Technician?" Would you like to have that title? You can prove you qualify for the title with a CET Associate Certificate. It can be your career door-opener and begin your rapid advancement!

A technician or student of electronics with less than a total of four years of basic experience may take the Associate Level Exam. The exam is the basic electronics portion of the full-credit CET exam. The 75-question, multiple-choice test covers basic electronics, math, DC and AC circuits, transistors and semiconductors, instruments, measurements and troubleshooting. A successful Associate CET will receive a wall certificate valid for four years and is eligible to join ISCET as an Associate Member. ISCET is the International Society of Certified Electronics Technicians.

The ISCET Computer-Aided Associate-Level Study Guide prepares you for the Associate CET Certificate by randomly selecting sample questions with appropriate diagrams, provides multiple-choice answers, grades the test and provides a summary of your strong and weak points.

Diskette requires IBM computer or compatible with VGA color monitor, 3.5-in. drive and a hard-disk drive.

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YES, I want to step up to a career in servicing. Here is my order for the CET Computer-Aided Study Guide on a 3.5 diskette. I am enclosing **$39.95** (price includes U.S. shipping and handling) in U.S. funds. Canadians and overseas add $6.00 per order for shipping.

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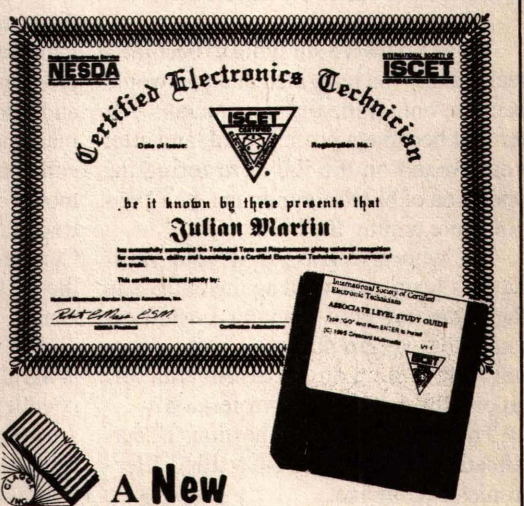
CB06

Proof Positive that you are a Certified Electronics Technician



A New Computer Software Program — ISCET Computer-Aided Associate-Level Study Guide

Prepare yourself for the 75-question CET Associate Examination. Model examinations provide the technician with a study program and introduction to the actual examinations. The model examinations are automatically graded in decimal numbers and bar graphs that can be outputted on your printer. The questions for each exam are selected randomly from a loaded data base—no two exams are exactly the same. When you answer a question, the correct answer is displayed and an explanation is given. From the printouts you will determine whether you need more practice and in which topic areas, or if you are ready to take the real test and continue to promote your electronics career today!

— Professional Technicians' Corner —

ISCET – Preparing Technicians for Today and Tomorrow

There is a place for technicians who have proven their abilities through certification. There is a place for proven-professional technicians to continue their training, and help elevate their industry to new levels. These places are the same one: a professional/fraternal society for concerned and caring technicians.

by William S. Warren CET/CSM

When you were studying to become a technician, you imagined that you would become one of the *best* technicians. After you became a professional, and after you worked on-the-job at restoring the operation of hi-tech equipment, you *knew* you were among the best.

But who else knows? If your skills haven't been measured against others in the industry, how do your customers know that you're not just a parts-swapper? How do you position yourself among the elite in your profession?

The answer to those questions is: certification. As in ISCET-Certified Electronics Technician.

And if you are, or become an ISCET-Certified electronics Technician, how do you continually enhance your professionalism, while promoting the betterment of your industry?

The answer to *that* question is the International Society of Certified Electronic Technicians (ISCET). That may be a long name, but it has a very short meaning: ***The Best.***

ISCET's mission is simple: to promote technical certification worldwide, and to provide a place for certified technicians to come together to advance their profession. Technicians wishing to tell the world they are the best can, through ISCET certifications, demonstrate they *are* the best.

Since our beginning, ISCET has taken this simple mandate, and forged ahead to become one of the preeminent technical certification organizations in the world. To date, we have certified over 47,000 technicians in various technical disciplines. While ISCET's roots are in consumer electronics, it has diversified into *all* segments of electronics servicing. ISCET is now a leader in certifications in fields as diverse as advanced audio and bio-medical electronics, to industrial and video. We have an extensive Associate program for students and apprentices with less than 4 years experience, to an unequalled Journeyman program for experienced technicians. In addition, we offer a number of journeyman endorsements in specialties such as camcorder, computer networking, and motor control. We are also a major contractor to the Federal Communications Commission (FCC) for implementation of the FCC Radiotelegraph certificates, licenses, and endorsements.

Not all programs are equal. ISCET is rightly proud that its certifications carry college credit recommendations by the American Council on Education's (ACE) College Credit Recommendation Service (CREDIT). ACE is not a self-serving trade group. It is the leader in its field, and the service most major colleges and universities turn to for credit recommendations. An official ACE transcript is a permanent, lifetime, computerized record of all exams and courses evaluated by ACE, and the ACE transcript is designed to facilitate the acceptance of ACE credit recommendations by colleges and universities.

Quick and easy access. That is ISCET's goal. While we offer access to many of our certifications through the national testing firm of LaserGrade, the backbone of our efforts remains our volunteer corps of over 400 members that have agreed to work as certification administrators. We are a professional society — of our members, by our members, and for our members. Our efforts emanate at the grass roots level and carry forward.

It's not just electronics either. While electronics is in our name, we also administer the Certified Appliance Technician (CAT) program for the National Appliance Service Technician Certification (NASTeC) program. This program, developed by the Association of Home Appliance Manufacturers (AHAM) and controlled by the Appliance Technician Certification Association is ISCET's latest addition to its stable of certification programs.

Did someone say training? The leader in certifications is a leader in technical training as well. ISCET is a source for extensive training for the electronics professional, from sample tests to detailed books; from computerized quizzes to interactive CDROM based training utilizing Electronics WorkBench. In addition, our members receive mailings on everything from job opportunities to technical papers by industry leaders.

Participation is easy. For more information on ISCET, or on how to join, contact the ISCET national office at 2708 West Berry Sreet, Fort Worth TX 76109-2397; 817-921-9101; Fax 817-921-3741. Or, go on-line at www.iscet.org. §

Editor's Note: *William S. Warren CET/CSM is the Imm. Past Chairman of ISCET and owner of Warren Electronic Services in Knoxville, TN.*

Interactive Study Modules Using Electronics Workbench

"Hands-on" study guides offer interactive simulation, and include multiple-choice questions that make use of the virtual lab capabilities

Note: *Student Electronics Workbench is* ***required*** *for use with Study Guides*

Quantity		*Member*	*Non-Member*
____	Student Electronics Workbench, Version 5.0	❑ $69.95 ea.	❑ $89.95 ea.
____	Associate Interactive Study Guide (78 questions)	❑ $39.95 ea.	❑ $49.95 ea.
____	Consumer Study Guide (35 questions)	❑ $49.95 ea.	❑ $59.95 ea.
____	Industrial Study Guide (28 questions)	❑ $49.95 ea.	❑ $59.95 ea.

Name _____

Address _____

City _____ State _____ Zip _____

Phone _____ Total Enclosed $ _____

Member of: ❑ NESDA ❑ ISCET

❑ Visa ❑ MasterCard No. _____ Exp. _____

Please allow 4-6 weeks for delivery when using personal checks. Money orders, cashier's checks and credit cards are processed in 10 days. Prices include domestic shipping. Foreign shipments, please add international postage, and specify Surface or Air. Texas residents multiply dollar amount by 8.25% for tax.

Mail to: ISCET, 2708 W. Berry St., Ft. Worth TX 76109; 817-921-9101; Fax 817-921-3741; www.iscet.org

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Name _____

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Member: ❑ ISCET; ❑ NESDA; ❑ Non-member

Texas residents multiply dollar value x 8¼% for taxes.
Foreign shipments please add international postage.
Send to ISCET, 2708 W. Berry St., Ft. Worth TX 76109

6.9¢/Minute Long Distance Service

NESDA's new LDS program through MCI/WorldCom, offers ...

- interstate rates of 6.9 cents per minute *(slightly higher for in-state calls)*
- good anytime, every day
- billing increments of six seconds
- calling card rate of only 14.9 cents/minute — and no surcharges *(unless using a public pay phone)*
- available for home and business; friends and neighbors, too.
- Residential rate 6.9 cents, no minimum usage
- no-cost switching from other carrier
- monthly fee of only $2 per- line, per-month for 800 or 888 service *(add'l fee for directory assistance listing)*
- rate negotiable for high volume
- no contracts; no monthly charge
- only $25 per month of L.D. usage to qualify
- Residential service not yet available in most markets

$20 Finders Fee: Receive a $20 check from Glenwood Communications for each new customer you recruit for the NESDAfone Plan who remains a customer for at least two months.

Glenwood Communications: 800-460-2242
"Ask for the NESDAfone Plan!"
(Present high-volume customers may be eligible for even lower rates.)

(NWSN, continued)

an elite group of professionals is rapidly emerging from the ranks.

These people are banding together into the NESDA World Service Network (NWSN). NWSN is a quality-service assurance program, and a combined worldwide marketing effort for volunteer companies. For an additional fee (over and above regular member dues), interested NESDA-member service companies can participate in an industry-wide marketing initiative aimed at promoting service industry businesses to consumers.

The new referral program, which involves internet marketing of member businesses, will only be open to NESDA members who wish to pay the additional fee ($300) and meet all qualifications of knowledge, competency, and certification. Members must employ at least one Certified Service Manager, and one Certified Electronics Technician, although they can be the same person. If prospective participants do not currently meet the rigid qualifications of NWSN membership, they may be admitted if they agree to attain the required credentials prior to August 1, 2000.

NWSN provides a set of guidelines and requirements for participating companies. The primary purpose of these rules is to assure consumers that members are ethical and competent within their stated fields of service. A rather extensive application may be filled out and submitted by email, or may be printed out and mailed into the NESDA office. Questions are gauged to measure each servicer's business longevity, ethical reputation, warranty affiliations, TPW affiliations, and competency for brands serviced, as well as types of service offered. And, as a commitment to quality customer service, each NWSN member agrees that there will be no unresolved complaints from their customers. Each complaint must be handled quickly, professionally, *and completely*. With proper guidance, NWSN can become the technical and ethical benchmark of reference for Better Business Bureaus, consumer agencies, and states' Attorney Generals' offices. It is hoped that the criteria for membership will be so recognized that it qualifies for national service center status.

The new web site for NWSN, www.nesda-nwsn.com, will be devoted to running the search engine behind the idea. Interested consumers will access the web site to search for participating members by zip code, area code, product types and brand names serviced. Each service participant's web site will be linked to the NWSN website to provide additional referral details involving such information as direction maps and hours of operation. In addition, a complete national marketing campaign is being considered that will publicize the concept of NWSN. Tentative lead-generating and service-referral agreements are in the works with a number of emerging manufacturing and sales organizations.

Obviously, NWSN isn't for every service organization. But if you and your company can meet the hard-hitting criteria — criteria that will soon be *required* by all seekers of services — you should be a part of it. The NWSN is destined to become a vital source of your important future business leads. §

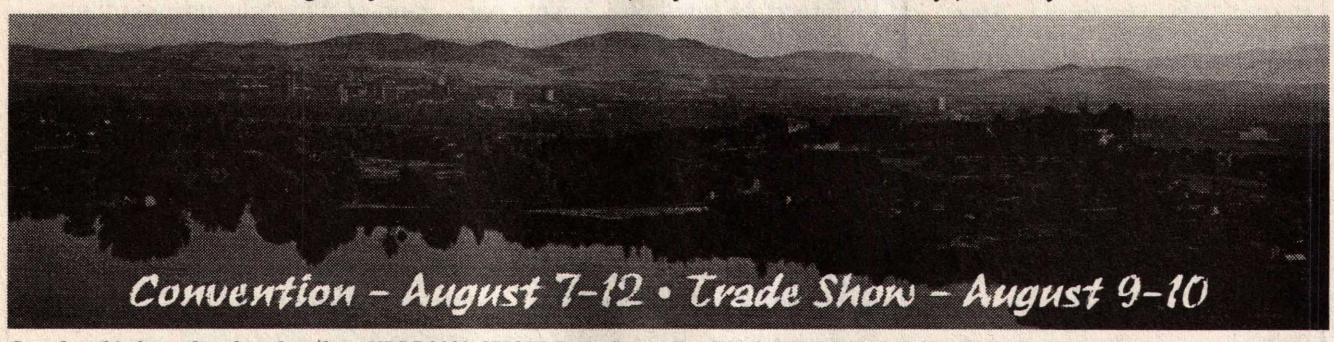
Editor's Note: *Gerry McCann CET/CSM is owner of McCann's Electronics, Metairie, LA, and host of the bi-weekly radio show,* Living with Home Electronics.

National Professional Service Convention2000

and Professional Service Trade Show

John Ascuaga's Nugget Hotel — Sparks (Reno) NV

Register for the Full Convention, Any Three Consecutive Days, or Daily



Complete this form, detach and mail to: NPSC 2000, 2708 W. Berry Street, Fort Worth, TX 76109; 817-921-9061; Fax 817.921.3741; www.nesda.com

Full convention registration includes all programmed meals, banquets, door prize drawings, trade show, dealer/manufacturer meetings, seminars and workshops. Activities may be scheduled for optional participation at an extra cost. There is no convention youth program. However, children 17 and under are free.

Name _____

Firm Name _____

Address _____

City _____ State _____

Zip _____ Phone _____

Member of (please check the appropriate boxes below):

❒ NESDA; ❒ ISCET; ❒ PSA; ❒ NARDA/NASD; ❒ Non-Member;
❒ Instructor; ❒ Speaker; ❒ Distributor; ❒ Manufacturer; ❒ Sales Rep;
❒ Press; ❒ Dealer; ❒ Technician; ❒ Other _____

NOTE: Special Registration Rates are valid ONLY on registrations ***completed, fully paid and received before the deadlines*** listed. "Three-Day Special" registration is available for any three consecutive days. Children age 17 and under are free. Convention fee schedule per person (ages 18, up):

If registered and fully paid by ...	Full Convention Registration	3-day Special	Daily	Totals:
Jan. 31, 2000	**$160**	**$120**	**$70**	**$ _____**
Mar. 31, 2000	$180	$140	$75	$ _____
May 15, 2000	$200	$160	$80	$ _____
Aug. 3, 2000	$220	$180	$85	$ _____
At the door	$250	$200	$90	$ _____

If registering for a 3-day special, check which 3 days you are registering:

❒ Mon.-Wed. ❒ Tues.-Thurs. ❒ Wed.-Fri. ❒ Thurs.-Sat.

Below, please print legibly ***your*** name, and the names of all other registrants (including nicknames) as they are to appear on the registration badges:

Check box if first NPSC	Full Name *(The one name you want in large letters)*	Badge Name	Youth Ages
❒			
❒			
❒			
❒			
❒			

Numbers of Participants/Length of Registration

# Adults Full: _____	# Adults 3-Day: _____	# Adults Daily: _____	Total No. of Days: _____
# Children Full: _____	# Children 3-Day: _____	# Children Daily: _____	Total No. of Days: _____

Make your check payable to NESDA

❒ **Visa** ❒ **MasterCard** **No.** _____ **Exp.** _____ **Signature:** _____

Special Room Rates: Deluxe room rates at John Ascuaga's Nugget Hotel are $89 single or double; $10 per person over 2 in the same room, max. 4. Children 18 years and under stay free with parents. Rates do not include room tax, currently 8%. Rooms are subject to availability. You may call the Nugget directly to make your reservations at 800-648-1177 (tell them you're reserving under the National Professional Service Convention) or by registration card provided by NESDA. ***Due to a city-wide celebration the week prior to NPSC 2000, our room-block does not begin until Sunday, August 6th. Hotel reservations beginning prior to August 6th are on your own. To guarantee a room at John Ascuaga's Nugget Hotel, reservations MUST be made by June 30.***

REFUND POLICY: Register in advance. If find that you have to cancel — any time prior to convention — all money prepaid will be refunded except for a 10% processing fee per registered person.

CHARLES D. RAKES

Receiver and Detector Circuits

Building and experimenting with receiver and detector circuits can be as much fun and as educational today as it was for the electronic pioneer of yesteryear. I firmly believe that the majority of electrical engineers and technicians in the first three-quarters of this century got their start in electronics by building either a crystal set or a tube or transistor broadcast receiver. At least the majority that I've talked to over the years have indicated that fact to me. We learn the best by doing—which is as true today as it was at anytime in our history.

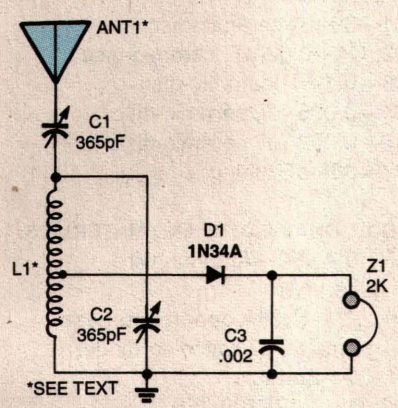


Fig. 1. This simple but functional crystal receiver—comprised of a germanium diode (D1), a hand-wound inductor (L1), and three capacitors (C1–C3)—can tune AM broadcast-band stations transmitting on a frequency ranging between 550 and 1600 kHz.

PARTS LIST FOR THE CRYSTAL RECEIVER (FIG. 1)

ANT1—Antenna wire (see text)
C1, C2—365-pF tuning capacitor (see text)
C3—0.002-µF, ceramic-disc capacitor
D1—1N34A general-purpose, germanium, switching diode
L1—See text
Z1—2000-ohm impedance headphones
Printed-circuit or perfboard materials, power source, wire solder, hardware, *etc.*

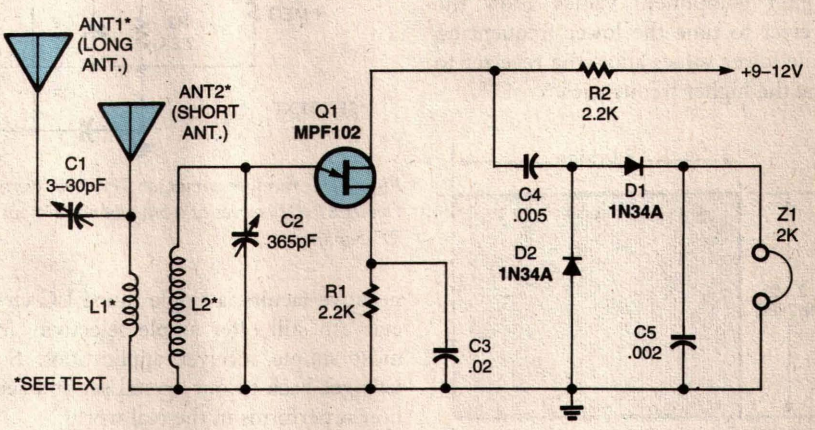


Fig. 2. Unlike the previous circuit, which includes no amplification and uses a single-diode detector—this simple receiver contains a single-stage, tuned-input RF amplifier and a dual diode detector.

If you've never built a receiver circuit from scratch and are not sure if your efforts would prove fruitful, then wait no longer because one of our receiver circuits could be your first step to a successful hobby or career. Even if you are an old hand, give one of these circuits a try and see how it compares to receivers of the past.

The first receiver circuit built by so many folks in the early days of radio was the elegant and simple crystal set. The crystal detector is an amplitude-modulated (AM) radio in its simplest form. AM is the only form of modulation that the crystal detector can unravel. CW, FM, single-side-band signals, and all other methods of modulation that are not amplitude in form cannot be received on a crystal radio. That was a problem in the early days of amateur radio because CW was the mode most often used. Only clicks could be heard when CW was received on a crystal radio.

Then along came a true genius, Edwin H. Armstrong, with his famous regenerative detector, which solved the problem. The regenerative detector is truly a multifaceted radio detector—bar none! In its simplest form, the regenerative receiver can unravel many forms of RF modulation, including AM, CW, FM, and single-side-band without requiring special circuitry for each mode. Not bad for a 1914 design—long before the general public knew what a vacuum tube was and how it would change their lives.

First things first, the elegant crystal set.

PARTS LIST FOR THE SINGLE-STAGE JFET RECEIVER (FIG. 2)

CAPACITORS
C1—3–30-pF trimmer or similar size variable
C2—365-pF tuning
C3—0.02-µF, ceramic-disc
C4—0.005-µF, ceramic-disc
C5—0.002-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
ANT1—Antenna wire (see text)
D1, D2—1N34A general-purpose, germanium, switching diode
L1, L2—See text
Q1—MPF102 JFET
R1, R2—2200-ohm, 1/4-watt, 5% resistor
Z1—2000-ohm impedance headphones
Printed-circuit or perfboard materials, power source, wire solder, hardware, *etc.*

Crystal Receiver

Our very first receiver entry this month is a simple, but functional, crystal set that can tune American and other AM broadcast-band stations transmitting on a frequency ranging between 550 and 1600 kHz. A schematic diagram of the circuit is shown in Fig. 1. The receiver's tuning range can be modified by changing the values of L1 and C2. Higher component values allow the receiver to tune the lower frequencies, while lower values allow the receiver to tune the higher frequencies.

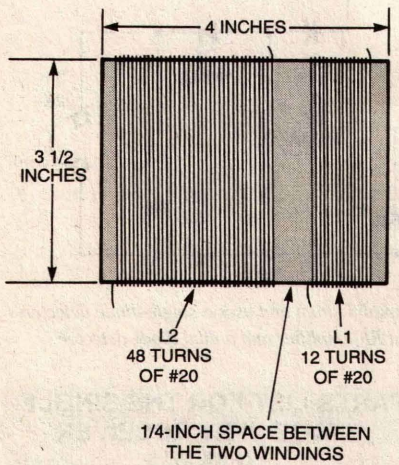


Fig. 3. Details for fabricating the homebrewed coils (L1 and L2)—which are comprised of a total of approximately 60 feet of #20 enameled wire wound on a 4-inch length of 3½-inch diameter PVC pipe—used in the Fig. 2 circuit is shown here.

If all of the signals present at an antenna were visible, it would no doubt look like the aftermath of an explosion at a spaghetti factory. That's because along with the desired signal you'd find an untold number of other RF signals covering the entire RF spectrum all jumbled together at the same antenna—all of them, of course, vying for a chance to meet your receiver's detector circuit.

The circuit's only frequency-selective elements are L1 and C2, which allow the receiver to select the desired station and to reject all other signals. Of course, in the real world things don't exactly happen that way. Strong out-of-band signals can override weaker signals—crowding out the desired frequency altogether. In addition, stations transmitting on adjacent frequencies, if strong enough, can crowd in and appear at the detector's output. The higher the Q factor or "Q" of the tuned circuit, the better the receiver's selectivity. In spite of all of the negative factors, a single tuned LC circuit can still offer ample selectivity in most simple receiver applications. So let's get back to our crystal set and see how it performs in the real world.

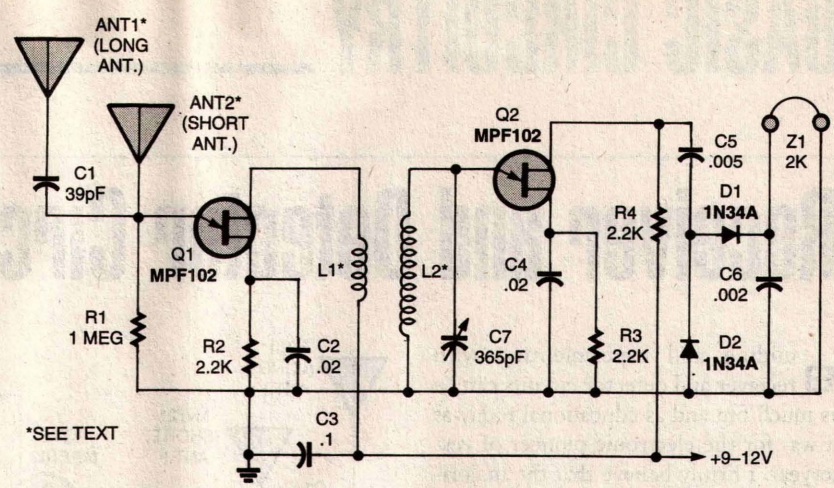


Fig. 4. This receiver circuit, an "evolved" version of our last circuit receiver, uses a pair of JFETs. One JFET (Q1) serves as a broadband RF-booster amplifier, while the other is configured as a tuned RF amplifier.

A good antenna and ground are a must for any crystal set to perform at its best. But if you live in an area where it's impossible to put up a long-wire antenna or drive a ground rod, it's still possible to receive a few local stations. Just about any length of wire over 20 feet strung around the room can be used for an antenna; the ground for the set can be another similar length of wire strung around another part of the room (to act as a counterpoise) and connected to the receiver's ground input. In any case, since the receiver circuit contains no amplification, the circuit's audio level depends on the strength of the RF signal and the length of antenna used.

Inductor L1 is comprised of about 75 turns of number 22 enamel-covered copper wire wound on a 2-inch diameter plastic form. A length of PVC pipe, a pill bottle, or any similar material can be used as the coil form. The detector tap is made at the 30th turn up from the bottom of the coil.

The two 365-pF tuning capacitors can be salvaged from old AM radios or purchased new. Very nice new 365-pF tuning capacitors are available from the Xtal Set Society, Box 3026, St. Louis, MO. 63130, or go to their Web site at *www.midnightscience.com* and look over the number of interesting crystal-set components. The detector diode, a 1N34A germanium unit, is available from RadioShack and most electronic mail-order houses. The circuit layout isn't critical, so just about any construction scheme—printed circuit, perfboard, experimenter's board, *etc.*—can be used as the component substrate.

PARTS LIST FOR THE TWO-STAGE JFET RECEIVER (FIG. 4)

CAPACITORS

C1—39-pF, ceramic-disc
C2, C4—0.02-μF, ceramic-disc
C3—0.1-μF, ceramic-disc
C5—0.005-μF, ceramic-disc
C6—0.002-μF, ceramic-disc
C7—365-pF tuning

ADDITIONAL PARTS AND MATERIALS

ANT1, ANT2—Antenna wire (see text)
D1, D2—1N34A general-purpose, germanium, switching diode
L1, L2—See text
Q1, Q2—MPF102 JFET
R1—1-megohm, ¼-watt, 5% resistor
R2–R4—2200-ohm, ¼-watt, 5% resistor
Z1—2000-ohm headphones
Printed-circuit or perfboard materials, power source, wire, solder, hardware, *etc.*

Single-Stage JFET Receiver

Our next receiver, see Fig. 2, uses a single-stage, tuned-input, RF amplifier with a dual-diode detector. In that circuit, an MPF102 JFET is used to amplify the incoming RF signal. The output of the amplifier is fed to a two-diode detector circuit that rectifies the amplified RF, sending a demodulated audio signal to the headphones. The Single-

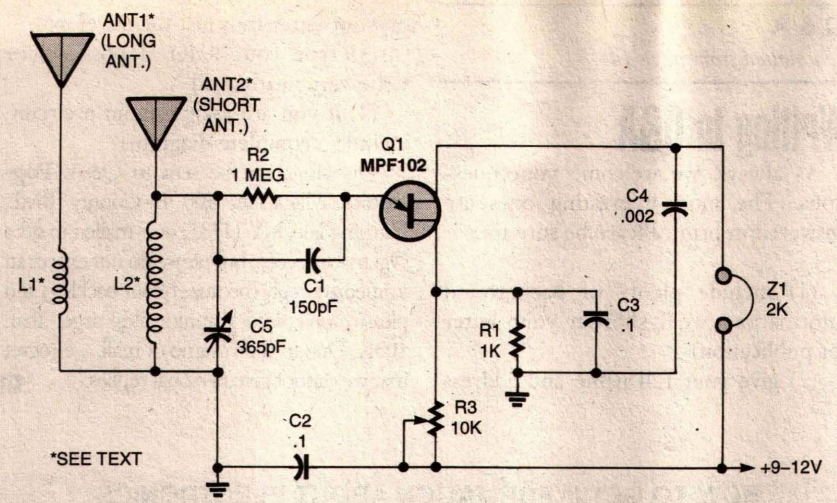


Fig. 5. This solid-state equivalent of a receiver (grid-leak detector) of a bygone era replaces the vacuum tube with a JFET (which operates somewhat like a triode vacuum tube in detecting RF signals).

PARTS LIST FOR THE GRID-LEAK DETECTOR EQUIVALENT (FIG. 5)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—1000-ohm
R2—1-megohm
R3—10,000-ohm potentiometer

CAPACITORS
C1—150-pF, ceramic-disc
C2, C3—0.1-µF, 50-WVDC,
C4—0.002-µF, 50-WVDC
C5—365-pF tuning

ADDITIONAL PARTS AND MATERIALS
ANT1—Antenna wire (see text)
L1, L2—See text
Q1—MPF102 JFET
Z1—2000-ohm headphones
Printed-circuit or perfboard materials, power source, wire solder, hardware, *etc.*

Stage JFET Receiver is a good performer that is well suited to receiving local stations using a short antenna and a short counterpoise for the ground.

The inductors in that circuit, L1 and L2, are a pair of homebrewed coils that were fabricated by hand-winding approximately 60 feet of #20 enameled-covered copper wire on a 4-inch length of 3½-inch diameter PVC pipe. Additional details for fabricating the coils are given in Fig. 3. Now would be a good time to wind the two coils, since the very same coils are used in most of the remaining receiver circuits. If the suggested wire size isn't readily available, try using the next closest size and adjusting the number of turns in the coil to obtain the desired tuning range. If the low-frequency end of the band can not be tuned, add a few turns to L2, and if the high-frequency end of the band won't tune, remove a few turns from L2. The best way to start out is to wind extra turns on L2 and remove turns if necessary to obtain the desired tuning range.

Two-Stage JFET Receiver

Our next entry, see Fig. 4, adds a broadband RF-booster amplifier to the receiver to increase sensitivity for use in a weak-signal area. Transistor Q1, an MPF102 JFET, amplifies all of the incoming RF signals and sends the output to the tuned RF amplifier (built around Q2) through L1 and L2. Inductor L2 along with C7 is used to select the desired frequency. The amplified-output signal of Q2 is converted to audio by a dual-diode-detector circuit, comprised of D1 and D2.

Inductors L1 and L2 are homebrewed coils fabricated as outlined in Fig. 3. The Fig. 4 circuit has more gain than the single-stage one, so it is important to keep all interconnecting leads between components as short as possible to prevent parasitic oscillatons.

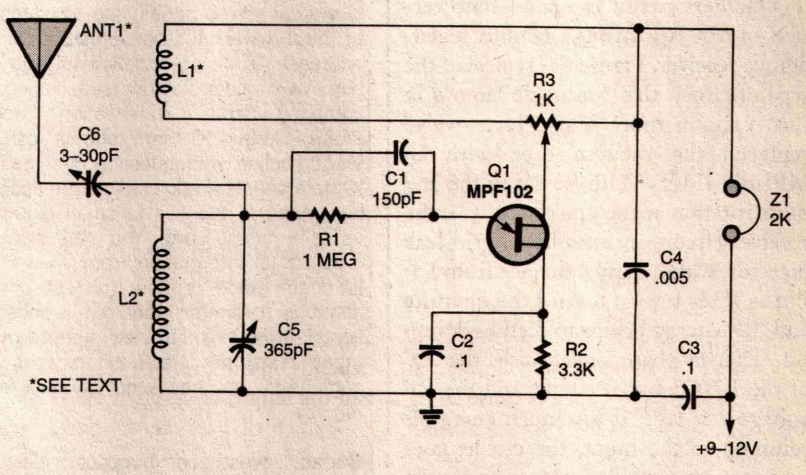


Fig. 6. The regenerative receiver, popularized during the radio era of yesteryear, replaces the vacuum tube used in the original design with an MPF102 JFET.

PARTS LIST FOR THE SOLID-STATE REGENERATIVE RECEIVER (FIG. 6)

RESISTORS
(All fixed resistors are ¼-watt, 5% units.)
R1—1-megohm
R2—3300-ohm
R3—1000-ohm potentiometer

CAPACITORS
C1—150-pF, ceramic-disc
C2, C3—0.1-µF,ceramic-disc
C4—0.005-µF, ceramic-disc
C5—365-pF tuning
C6—3–30-pF trimmer

ADDITIONAL PARTS AND MATERIALS
L1, L2—See text
Q1—MPF102 JFET
Z1—2000-ohm impedance headphones
ANT1—Antenna wire (see text)
Printed-circuit or perfboard materials, power source, wire solder, hardware, *etc.*

Grid-Leak Detector Equivalent

Our next circuit, see Fig. 5, is very similar to a popular old vacuum-tube circuit, the grid-leak detector. Here we've replaced the tube with the modern JFET, which operates somewhat like a triode vacuum tube in detecting RF signals. The major difference between the vacuum-tube receiver and the solid-state version is in the operating power. The tube's filament, even on a battery-type tube, alone consumes several times the power the JFET receiver uses.

The desired incoming signal is selected via an LC network, comprised of L2 and C5, and fed to the JFET's gate where it is detected and amplified, after which the signal is sent on to the phones. The JFET operates best as a detector when the gate bias is set near its cut-off value. Since JFET characteristics vary from device to device, the tuning range of R3 allows the bias to be set to its optimum value for RF detection.

Solid-State Regenerative Receiver

Our next circuit is a solid-state version of Mr. Armstrong's famous regenerative receiver. Figure 6 is typical of the type of circuit that was made famous in the vacuum-tube era. Here we've replaced the vacuum tube with an MPF102 JFET. With R3 set to the end of its rotation at the junction of C4, the receiver circuit operates like a grid-leak detector, without any influence from L1. But as R3 is turned toward the opposite end, RF energy begins to feed back into L2. That in-phase signal raises the "Q" of the L2/C5 tuned circuit and the RF voltage across it. If too much energy is returned to the input, the circuit goes into sustained oscillation and no longer behaves like a detector. Having R3 connected across the feedback winding gives the circuit excellent stability and very little frequency shift when regeneration adjustments are made. The circuit's transition to and from regeneration is very smooth.

Often in the tube-equivalent circuit the potentiometer is connected in a rheostat configuration across the feedback coil (tickler for the old timers), which changed the loading on the main tuned circuit each time the regeneration control was adjusted. That would cause a frequency shift in the tuned circuit each time the regeneration control was turned. P

Q & A

(continued from page 14)

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

(1) include plenty of background information (we ll shorten your letter for publication);

(2) give your full name and address on your letter (not just the envelope);

(3) type your letter if possible, or write very neatly; and

(4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Poptronics** Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mailed to q&a @gernsback.com, but please do not expect an immediate reply (because of our backlog) and please don t send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies. P

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On the Internet: See our Web site at *www.gernsback.com* for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci. elec tronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio. amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at http://www.hitex.com/chipdir/, or try addresses such as http://www.ti.com and http://www. motorola.com (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmaster.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at *www.repairfaq.org*

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising over 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1995 only) are available from our Claggk, Inc., Reprint Department, P.O Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (http://www.arrl.org). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

Service Clinic

SAM GOLDWASSER

VCRs

This month we'll begin a series of *Service Clinic* articles on troubleshooting and repairing video-cassette recorders—VCRs. Unlike computer monitors, problems with VCRs are mostly mechanical—dirty or deteriorated rubber parts, gummed up lubrication, and sometimes even strategically placed foreign objects, like toys or rocks, or peanut butter and jelly sandwiches! And, since the VCR mechanism is much more complex than that of a CD or DVD player, some routine maintenance is prudent. We'll kickoff this month with some information on video recording technology, VCR placement, preventive maintenance, and rental tape considerations.

Then, we will delve into the various types of malfunctions that are likely to occur. As with the other types of repair that we've discussed, some of the most catastrophic problems have the simplest solutions!

Entertainment—Then and Now

Think back 25 years. You went to the theater to see a movie. You watched TV programs when they were broadcast (there was no cable) or you missed them. TV studios and industry had video recording equipment, but it was expensive and cumbersome. Little did you realize at the time, but after some false starts, the modern video revolution was about to be born. Are we better off? Whatever you decide, there is no going back. And we just can't escape the impact that this technology has had on so many aspects of our lives.

The video cassette recorder is a wonderful example of extremely complex, precision technology that has been made affordable through mass production. In general, VCRs are usually quite reliable. Treat a modern VCR with a bit of respect, and it will provide trouble-free service for a long time. Unlike a TV where the power circuits take their toll on circuit components, the electronics in VCRs are generally quite reliable and rarely fail. As mentioned above, most VCR problems are mechanical—dirt and dust in the tape path, dried lubrication, wear of precision parts including the spinning video heads, and abuse.

Repair or Replace

While VCRs with new convenience features are constantly being introduced, the basic function of playing a tape has not changed significantly in 25 years. Even the introduction of HQ about 15 years ago does not represent a dramatic improvement. Therefore, unless you really do need a quick start transport, a real-time counter, index search, or the like, repair may not be a bad idea. The older VCRs are built much more solidly than the $150 models of today. Even high-end VCRs may be built around a poorly designed transport and flimsy chassis. Many older VCRs—for example, 10-year-old Panasonic models (and their clones)—can be kept functional almost indefinitely at minimal cost.

Video Recording Technology

Helical scan video recording: Modern VCRs—both consumer and professional—are based on what's known as helical scan recording. The main technological challenges that confronted the designers of early video-recording machines was achieving the necessary bandwidth (several MHz) to faithfully capture the high-frequency video signal. The first such machines ran normal audio tape past stationary recording heads at high speed (tens of feet per second) in an attempt to solve that problem.

Needless to say, the mechanisms were complex, a finite length of tape could only record a few minutes of video, and the heads wore out almost as quickly. If anything went wrong with the tape transport, you were up to your eyeballs in spilled tape. An alternative technology was clearly needed.

Prior to practical video-tape recording, the only way to preserve a TV show was to use special equipment that essentially made a film of it off of a video monitor. The quality of such recordings was not very good, editing was difficult, the film needed to be developed so playback was not immediate, and, of course, the film could not be erased and reused.

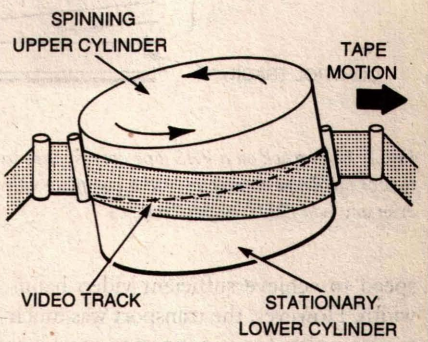

Fig. 1. In the Helical scan format, rather than scanning across the tape, the tape is wrapped a bit over 180 degrees around a rotating drum at a slight angle, allowing successive tracks to be written diagonally across the tape, as illustrated here.

The first successful commercial video tape recorder was introduced around 1956 with the Ampex Quadplex—a $50,000 machine using 2-inch open-reel tape and a high-speed spinning head with four pickups rotating across the tape. That machine revolutionized commercial broadcasting. However, the technology was much too complex, cumbersome, and expensive for consumer use; and it had a number of technological disadvantages as well.

For a consumer video-tape recorder to be successful, it was felt that three major hurdles had to be overcome:

- Tape loading had to be simple and foolproof using a cassette—none of this open reel stuff.
- A cassette had to hold at least an hour of color video.
- The cost to the consumer had to be less than $1000 (1970's dollars!) for the machine and perhaps $20 per hour for the tape.

The rotating heads of the Quadplex machine provided the needed tape-head

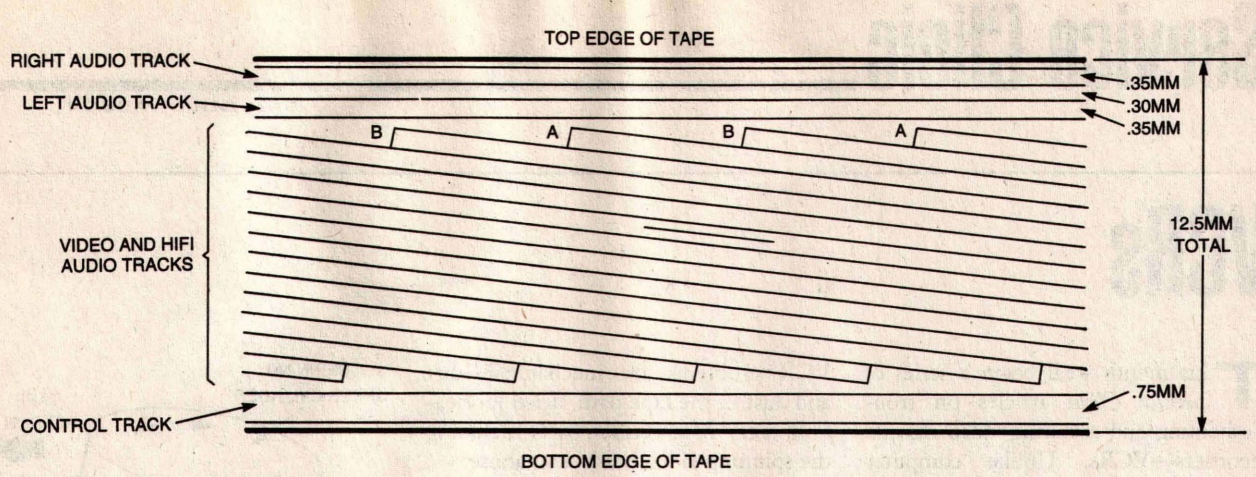

Fig. 2. Each track on a VHS tape corresponds to one field of the interlaced video format. One rotation of the drum corresponds to a complete video frame with the heads designated A and B for the even and odd fields, respectively.

speed to achieve sufficient video bandwidth. However, the transport was much too complex for a consumer machine. Another disadvantage was that since a video frame consists of many adjacent tracks (16) on the tape, special effects like stop motion as well as forward and reverse search were not possible without a frame store. While that would not be out of the question today, the cost of such a device in the 1950's would necessitate the consumer taking out a second mortgage to pay for the equipment.

In addition to those negatives, the 2-inch wide format required too much tape to achieve a cost-effective 1-hour program time and made the design of a manageable cassette an impossibility. With the 2-inch wide format, one would need a separate room to house a modest-size, video-tape library!

Helical scan overcomes most of those problems. Rather than scanning across the tape, the tape is wrapped a bit over 180 degrees around a rotating drum at a slight angle (as shown in Fig. 1). Thus, successive tracks are written diagonally across the tape and can thus be much longer than the width of the tape as in the Quadplex. The tape, therefore, can be rather narrow. The first helical-scan tapes used a 1-inch format, but narrower tape soon followed. The most common formats today are forms of VHS (and Beta) at 1/2-inch, and 8-mm (mostly used for portable applications in camcorders and data storage), and 4-mm tape, which is used for high-quality audio (DAT) as well as data storage.

VHS Video

Most of the following discussion, unless otherwise noted, applies to the VHS format. Beta—which preceded VHS into the marketplace and has all but disappeared for consumer VCRs—is actually a somewhat better system, from a technological standpoint, with its superior picture quality. Physically, the tape format is similar to VHS, but differs in the details. However, Sony's licensing practices with respect to Beta made it inevitable that VHS would triumph in the marketplace. Too bad in some ways. (The 8-mm format, mostly used nowadays in camcorders, is also a form of helical scan, but has no separate audio and control tracks—they're part of the video track.)

Each VHS track corresponds to one field of the interlaced video format. Generally, two heads opposite each other on the rotating head drum are used. One rotation of the drum corresponds to a complete video frame with heads designated A and B for the even and odd fields, respectively (see Fig. 2). That also provides the ability to easily implement a variety of special effects, including freeze frame, and fully variable-speed forward and reverse motion with a recognizable and, in many cases, quite clear picture. With relatively minor restrictions, that becomes as simple as moving the tape forward or backward or keeping it stationary. (Camcorders and other compact systems may use four heads on a smaller drum to reduce size, but the recorded format is identical.)

The A and B heads are not identical either. Their azimuth angles (see Fig. 3) differs—+6 degrees for one and −6 degrees for the other. That's one of several techniques used to minimize crosstalk between adjacent tracks. Azimuth angle is how far the head gap is from being perfectly perpendicular to the direction of tape-tape motion. For example, a head with an azimith such as "/" will ignore most of the information recorded with an azimith of "\."

Note that the head gap—the distance between pole pieces—is on the order of 1 micron (1 μm)—1/25,000 of an inch. As a point of reference, a human red blood cell is about 7 μm in diameter and an average sheet of typing paper is about 100 μm in thickness. The gap is filled with a nonmagnetic material to prevent it from getting clogged and to force the magnetic flux out of the head structure and onto the tape's magnetic coating. That remarkably fine spacing is necessary to achieve the multimegahertz video bandwidth.

The actual tape motion for a VCR is remarkably slow. To someone familiar with audio decks, the tape in a VCR even at the fastest speed (SP) seems to be crawling along. Their first reaction is often one of "There must be something wrong as the tape is moving sooo slooowly." Nope, just amazing technology. The SP speed of a VHS VCR corresponds to a linear tape speed of only 1 5/16 inches per second (ips)—slower than that of an audio cassette deck (1 7/8 ips): EP speed is 1/3 of that—7/16 ips. However, the effective tape speed as seen by the video heads is over 15-feet per second due to the spinning video-head drum.

The luminance (Y) and color (C) components of the composite-video signal are recorded differently. Luminance, which is in effect the black and white picture with all the high-resolution

components but no color, is frequency modulated on a carrier at around 3.4 MHz. The deviation is about 1 MHz and the maximum-frequency recorded on a VHS tape is a little over 5 MHz (Beta is slightly different and S versions of Beta and VHS extend some of those to achieve higher bandwidths). The color signal is separated from the composite video and is amplitude modulated on a 629-kHz carrier. That's called the color under system. The "U" in U-Matic, a very popular industrial VCR ¾-inch format (which predates Beta and VHS and is still in use), stands for that.

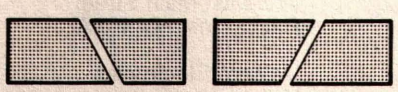

Fig. 3. The azimuth angles of the A and B heads differ—+6 degrees for one and −6 degrees for the other—as illustrated here.

VHS Audio

Sound for the VHS format is not merged into the video signal on the tape. For non-hi-fi VHS VCRs, a separate stationary tape head is responsible for the audio signal. Due to the very slow tape speed, audio quality is not even comparable to a cheap audio-cassette player even at the SP speed. VHS hi-fi overcomes that deficit by FM recording of the audio signal deep in the tape (recorded by a separate set of hi-fi heads just before the video information) and actually buried under the video information. The left- and right-audio channels are recorded in separate frequency bands—centered around 1.3 and 1.7 MHz, respectively. The azimuth angles for the hi-fi audio heads are ±30 degrees, which minimizes crosstalk between the recorded hi-fi audio and video information.

Since the head-tape speed for the VHS audio track is the same high rate as for the video track and exceeds that of a typical audio-cassette deck by a factor of more than 100, VHS hi-fi audio reproduction—frequency response, signal-to-noise ratio, and dynamic range—is excellent and approaches that of a CD. In fact, using a T120 video cassette in EP (SLP, 6 hour) mode simply to record stereo music (with the video ignored or blanked) is extremely cost effective. What other media/technology will store a 6 hour concert with nearly perfect reproduction for under $2? (Note: If you do that, some VCRs will require some kind of video input to maintain stable tape speed. You can just ignore the video portion on audio playback.)

There are two disadvantages to VHS hi-fi, however: First, there may be some degradation of video quality due to unavoidable interactions with the buried audio, and second, it is not possible to rerecord (dub) only the audio without disturbing the video.

VCR Servo Systems

Linear tape motion and head-drum rotation must be precisely synchronized during record, play, and special-effects play modes. The general functioning is similar for all, but the source of the basic reference signal differs for play and record. Some of the specific relationships may differ depending on the specific VCR design.

In the record mode, the reference signal is a vertical-sync pulse derived from the video input:

- Head drum rotation is phase locked to vertical sync pulse so that the appropriate head (of the A-B pair) is in contact with the tape during the appropriate video field.
- The speed of the capstan, which moves the tape through the transport, is also locked to the vertical sync pulses so that the selected linear tape speed (SP, LP, or EP) is maintained.
- Control pulses (30 Hz for US NTSC) are recorded along the bottom edge of the tape by a stationary control head.

The play mode reference signal is timing pulse derived from a quartz oscillator:

- Capstan rotation speed is locked to a 30-Hz pulse derived from a precise quartz-crystal oscillator. Head-drum rotation is phase locked to the control pulses now being read from the tape by the control head.
- The tracking control is used to adjust the relative phase of the head drum with respect to the control pulses. That permits the head path across the tape to be aligned with the actual recorded tracks.

Video Special Effects

For CUE (fast play forward) and REV (fast play reverse), the capstan speed is phase locked to a multiple of the control track. Since the video heads are crossing multiple tracks during these modes, some noise bars are unavoidable. At SP speed, special-wide or dual-azimith heads are required to minimize degradation. Thus, only 4-head VCRs can play SP tapes at fast speeds with minimal noise. With EP speed, the tracks actually overlap and a normal video head is wide enough to pick up enough signal from adjacent tracks to produce a mostly noise-free picture. Due to the way adjacent tracks line up with LP speed, most of the special effects cannot be used due to serious tearing of the picture.

The sophisticated processing needed for proper support at LP speed is generally not included in modern VCRs due to the apparent lack of interest in the LP speed (recording support at LP speed seems to be absent in more and more newer VCRs, although they'll all play back LP tapes at normal playback speed).

Really slow speed is usually implemented as a variable-frame advance with the tape fully stopping between frames. Special sets of video heads provide the best quality. Freeze frame (PAUSE) uses the same set of heads. As with CUE and REV, acceptable picture quality is provided even with a 2-head VCR for EP-speed recorded tapes. In all cases, picture quality can be further improved through the use of a digital-frame store.

Note that the servo systems in consumer VCRs are rarely precise enough to implement the kind of instantaneous forward or reverse frame advance that is present in high performance (and high cost) editing decks, which have jog shuttle knobs with instantaneous and precise response.

Wrapup

That's it for now. Next time we'll begin to deal with some preventive maintenance you can perform on your VCR, as well as take a tour inside a typical VCR. We'll also examine basic cleaning procedures, and the most common problems, like tape eating. Until then, check out my Web site, *www.repairfaq.org*. I welcome comments (via e-mail only please) of all types and will reply promptly to requests for information. See you next time! P

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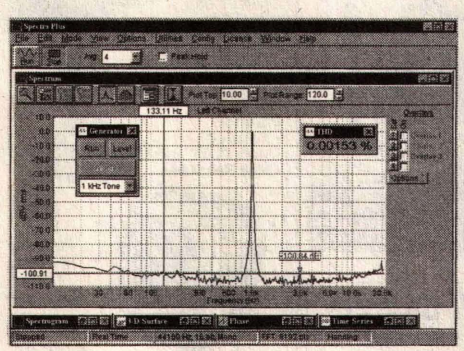

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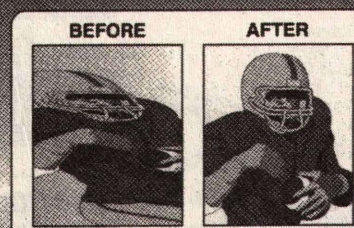

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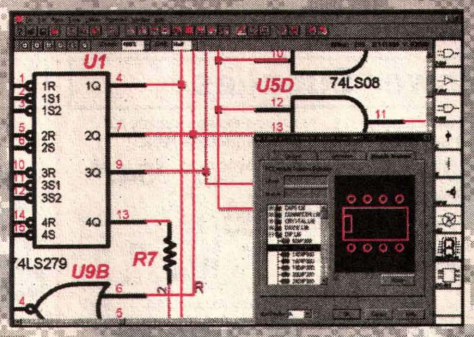

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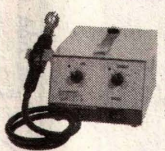

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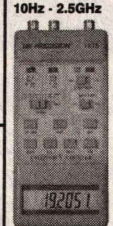

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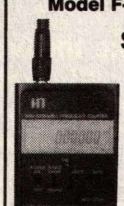

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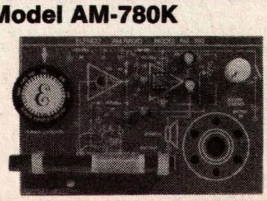

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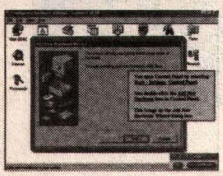

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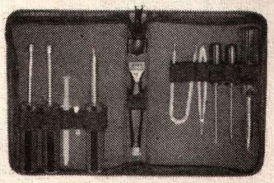

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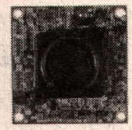

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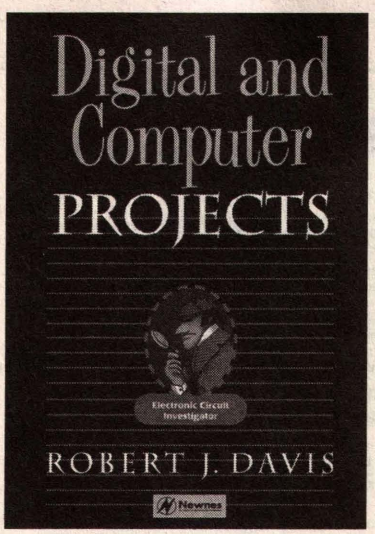

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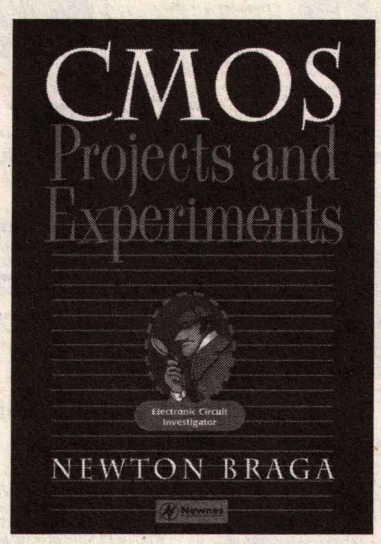

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CIRCLE 310 ON FREE INFORMATION CARD

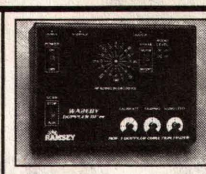
RAMSEY Cool Wireless Goodies

World's Smallest TV Transmitters

We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air! These are the units that are being built into hats, pagers, cigarette packs and sold for big $$!!

C-2000, Basic Video Transmitter.....$89.95
C-2001, High Power Video Transmitter...$179.95
C-3000, Basic Video & Audio Transmitter.....$149.95
C-3001, High Power Video & Audio Transmitter....$229.95

Doppler Direction Finder



Track down jammers and hidden transmitters with ease! This is the famous WA2EBY DF'er featured in April 99 QST. Shows direct bearing to transmitter on compass style LED display, easy to hook up to any FM receiver. The transmitter - the object of your DF'ing - need not be FM, it can be AM, FM or CW. Easily connects to receiver's speaker jack and antenna, unit runs on 12 VDC. We even include 4 handy home-brew "mag mount" antennas and cable for quick set up and operation! Whips can be cut and optimized for any frequency from 130-1000 MHz. Track down that jammer, win that fox hunt, zero in on that downed Cessna - this is an easy to build, reliable kit that compares most favorably to commercial units costing upwards of $1000.00! This is a neat kit!!

DDF-1, Doppler Direction Finder Kit $149.95

CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infra-Red) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80º) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens $69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens..... $69.95
CCDCC-1, Color CCD Camera, wide-angle lens $129.95
IR-1, IR Illuminator Kit for B&W cameras $24.95
IB-1, Interface Board Kit..... $14.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

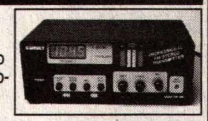
AR-1, Airband 108-136 MHz Kit..... $29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit $34.95
FR-1, FM Broadcast Band 88-108 MHz Kit..... $24.95
FR-6, 6 Meter FM Ham Band Kit $34.95
FR-10, 10 Meter FM Ham Band Kit..... $34.95
FR-146, 2 Meter FM Ham Band Kit..... $34.95
FR-220, 220 MHz FM Ham Band Kit..... $34.95
SR-1, Shortwave 4-11 MHz Band Kit..... $29.95
Matching Case Set (specify for which kit)..... $14.95

Touch-Tone Reader

Read touch-tone numbers from any radio, phone line, tape recorder - any audio source! Decipher called numbers on scanners, radio shows, anywhere touch-tones are used. Memory stores up to 256 digits, an 8 digit display window scrolls anywhere in memory. Memory good for 100 years, even with power off! Runs on 7 to 15 volt DC, Available in kit form with optional matching case set or fully assembled in case set. We sell tons of these to private investigators!

TG-1, Tone-Grabber Touch Tone Reader Kit..... $99.95
CTG, Case for Tone-Grabber Touch Tone Reader $14.95
TG-1WT, Tone-Grabber, fully assembled with case..... $149.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Super Pro FM Stereo Transmitter



Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. *We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.*

FM-100, Pro FM Stereo Transmitter Kit $249.95
FM-100WT, Fully Wired High Power FM-100..... $399.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized Stereo Transmitter Kit $129.95

Lower cost alternative to our high performance transmitters. Great value, easily tunable, fun to build. Manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add our matching case and whip antenna set for nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit..... $34.95
CFM, Matching Case and Antenna Set $14.95
FMAC, 12 Volt DC Wall Plug Adapter..... $9.95

Tiny Transmitters

Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger, more powerful, runs on 5-12 volts, goes up to a mile. FM4,5 operate in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & loose a part!

FM-4MC, High Power FM Transmitter Kit $17.95
FM-5, World's Smallest FM Transmitter Kit..... $19.95
FM-6, Crystal Controlled 2M FM Transmitter Kit ... $39.95
FM-6, Fully Wired & Tested 2M FM Transmitter $69.95

FM Station Antennas

For maximum performance, a good antenna is needed. Choose our very popular dipole kit or the Comet, a factory made 5/8 wave colinear model with 3.4 dB gain. Both work great with any FM receiver or transmitter.

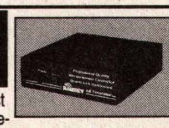
TM-100, FM Antenna Kit $39.95
FMA-200, Vertical Antenna $114.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case..... $99.95

AM Radio Transmitter



Operates in standard AM broadcast band. Pro version, AM-25, is synthesized for stable, no-drift frequency and is setable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 is tunable, runs FCC maximum 100 mw, range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set that dresses up the unit. Great sound, easy to build - you can be on the air in an evening!

AM-25, Professional AM Transmitter Kit $129.95
AM-1, Entry level AM Radio Transmitter Kit..... $29.95
CAM, Matching Case Set for AM-1..... $14.95

Dinky Radios

Everyone who sees one of these babies says they just gotta have one! Super cute, tiny (that's a Quarter in the picture!) FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. The crystal clear sound will amaze you! Makes a great gift.

MFMT-1, World's Smallest FM Radio..... $11.95
PFMR-1, Pager Style LCD Clock & FM Radio $12.95

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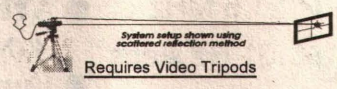

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LWB9 Plans and all Data for 3 Laser Window Bounce Systems.....**$20.00**
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Those With Lasers Only Need Our: **#LLR3K** Optical Receiver Kit.....**$69.50** or **#LLR30** Ready to Use Optical Receiver.....**$99.50**

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500KV Stun Gun!!

Intimidatingly effective up to 20' with explosive spark discharge. Easily consealable

SIZZ500.....**$79.95**

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More stopping power than most hand guns!! 15 foot knock down range. Easily concealed Uses non lethal technology.

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Produces 30" Sparks

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Star Wars Technology Directs Energy

Star Wars Technology Demonstrates Weapons Potential, Force Fields, IonMotors, Antigravity etc. ***Projects electric shocks without contact!!*** Conduct many weird and bizarre experiments. Handheld battery operated and easy to operate.

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Higher Powered Device
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6 FM Xmtr Kits!

1. Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter.
2. 1 Mile+ Telephone Transmitter.
3. Line Powered Phone Transmitter Never Needs Batteries!!
4. Tracking/Homing Beacon Beeping Transmitter
5. Video/Audio Rebroadcaster 1 Mi.
6. TV/FM Radio Disrupter. Neat Prank! Discretion Required

Includes Hints Using Wireless Devices

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TAKE CONTROL Using Electronic Hypnosis

Electronic circuitry induces hypnotic as well as ALPHA relaxed mind states. Place subjects under your control

HYP2 Plans.....**$10.00**
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MIND2 Plans for Mind Control..**$15.00**
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Caution! Do not aim at people!

Blast out rodents with high power ultrasonics.

Handheld and battery operated with all controls.

Rental units available.

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PPP1K Kit/Plans.....**$49.95**
PPP10 Ready to Use.....**$79.95**

Shock Force Field Vehicle Object Electrifier

Hand shock balls,wands. Mini circuit is easily hidden. Great payback for those wise guys.

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Complex Magnetic waves are claimed to produce many health benefits. Board level experimental device is sold for research purposes only.

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Current and Future Weapons Systems

We Stock Parts!

CO2 Lasers can cut thru most metals
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Build a Magnetic Cannon!!!

Experiment with and Construct Rail Guns, Magnetic Launchers, Coil and Sleeve Guns, Super High Gravity Pulses, Explode Wires and Water, Antigravity, Levitation, Mass Warping, Magnetic Can Crushing, Plasma Propulsion, High Energy Radio Frequency Guns (Herf), EMP, Lattice Snapping, and all Types of Electrical Pyrotechnics, Plus Much More!!

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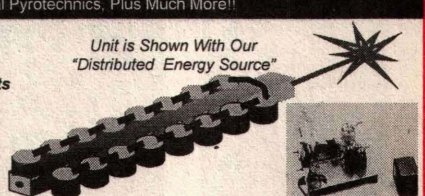
Unit is Shown With Our "Distributed Energy Source"



HEP3 Plans 500-1Kj @ 1-2 Kv **$15.00**
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Custom Designs Available on Request

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28 pages of data related to the most revolutionary advance in transportation. Cutting edge R&D

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Lights up a 4' fluorescent tube-all without any contact!! Yet only 3" tall!!

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Amazing and bizarre effects turn a normal light bulb into a spectacular plasma display!! With adjustable frequency control. Safe 12vdc input

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Pyrotechnical traveling fiery plasma expands over 3" before evaporating into space. Solid state circuitry with adjustable arc control. 115/230 volt operation. Uses safe high frequency energy.

JACK1 Plans.....**$8.00**
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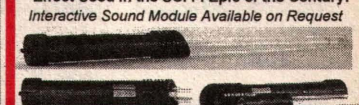
Patented Moving Light Concept Duplicates the Effect Used in the SCI FI Epic of the Century!
Interactive Sound Module Available on Request



Available Colors "C" *photon blue, starfire purple, phaser green* and *neon red.*

MINISAB "C" 15" Active Length.....**$49.95**
SAB24 "C" 24" Active Length.....**$69.95**
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*Please add $10.00 for special handling

Telephone Line Grabber Room Listener Controller and Call Diverter

Listen to your premises. Break in to calls Control household appliances. Remote dial long distance calls-from anywhere!!

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Attention! High Voltage Modules

Battery powered for hovercraft, plasma guns, anti gravity, force fields, pyrotech

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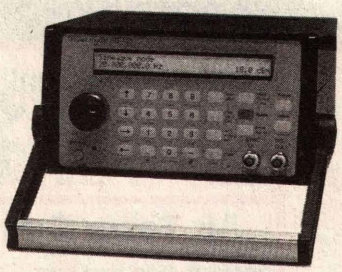

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- ✔ 21.5 MHz
- ✔ .01 Hz steps
- ✔ multi-unit phaselock

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  Clean sinewaves DC-21.5 MHz, .001% accuracy! .01 Hz steps. DC Offset. RS232 remote control.
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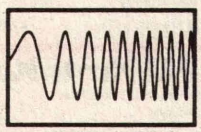
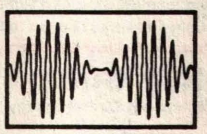
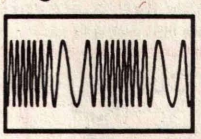
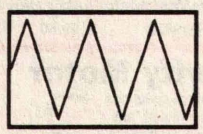
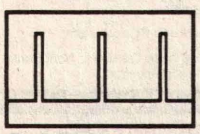

DC to 21.5 MHz linear and log sweeps

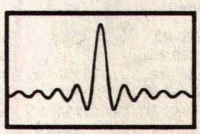

Int/Ext AM, SSB, Dualtone Gen.

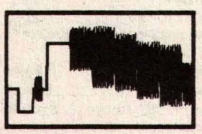

Int/Ext FM, PM, BPSK, Burst


Ramps, Triangles, Exponentials


Pulse Generator

Noise


Arbitrary Waveforms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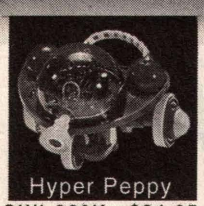
Hyper Peppy
OWI-969K: $24.95
Fast, 3 wheeled robot with a touch/sound sensor

Line Tracker
OWI-963K: $49.95
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Triple Action Solar Car
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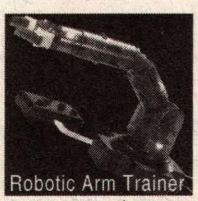
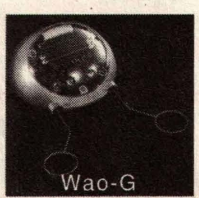
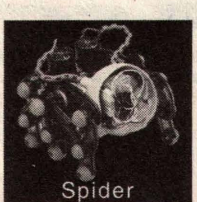
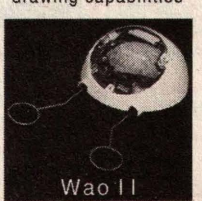
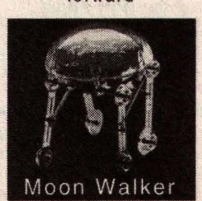

Robotic Arm Trainer
OWI-007: $69.95
Highly acclaimed award winner


Wao-G
OWI-968K: $89.95
48 fuzzy logic programming steps and drawing capabilities

S-Cargo
OWI-936K: $36.95
Sound sensor controls it to spin, stop, and go forward


Spider
OWI-962K: $49.95
Infrared sensor detects solid obstacles in its path


Wao II
OWI-961K: $69.95
Learn how to program in simple Basic language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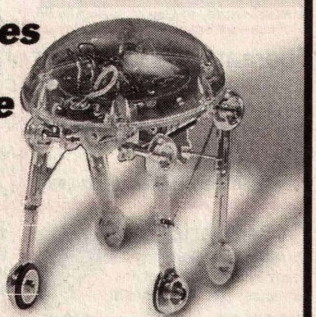
Will walk when it detects a change in light

While supplies last, purchase any four of the robotic kits shown at left, and receive a Moon Walker Robotic Kit absolutely FREE!


Moon Walker

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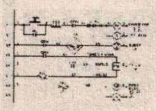
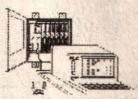
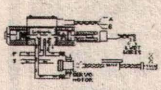


RC-M ONLY $165 RC-M is a 15 hour training course on relay ladder logic systems. Includes a 5-part video and workbook. **Great Value!**



PLC-M ONLY $198 PLC-M is a 32 hour training course on PLC systems. Includes (2) 4-part video's and workbook. **This training is valuable.**



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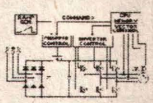

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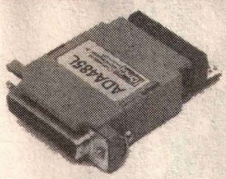

CMC's low cost converters adapt any RS232 port for RS422 or RS485 operation. These converters provide your RS232 device with all the advantages of RS422 or RS485 including reliable high speed operation (up to 200 kbaud) and data transmission distances up to 5000 feet. Two AD422s can be used to extend any RS232 link up to 5000 feet. Completely transparent to the system; no software changes of any type are necessary.

RS232 TO RS485 2 wire

- **Makes your RS232 port an RS485 port**
- **Supports up to 40 RS485 devices**
- **Automatically determines data direction.**
- **Signal powered version available**

ADA485 (requires 9VDC)	$79.00
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ADA485L signal powered	84.00

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- **Converts bi-directionally between RS232 and RS422**
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- **Plug in and go. No software changes required**

AD422 (Requires 9VDC)	$79.00
AD422-1 for 110VAC	89.00

RS232 TO RS485 4 wire

- **Converts an RS232 port for use with RS422 or RS485 devices**
- **Supports up to 40 RS485 or RS422 multidrop devices**
- **Adds multidrop capability to RS232 devices**
- **Automatically determines data direction.**

ADA425 (requires 9VDC)	$89.00
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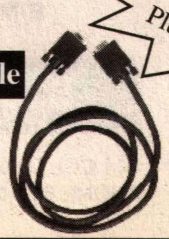

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TE-068-L5	7ft. Straight Patch	$2.00
TE-128-L5	14ft. Straight Patch	$4.00
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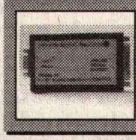
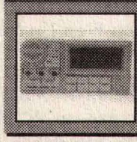
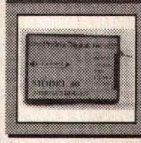
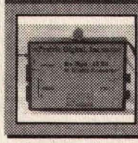

- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 ..... $279

- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 .... $179

- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 ..... $109

- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 ..... $239

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* Analog Output
* 400KHz Sampling

DIG100 Digital I/O ..... $ 39

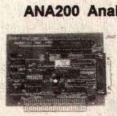
* 82C55 PPI
* 24 or 48 TTL I/O Lines option
* Selectable Base Address

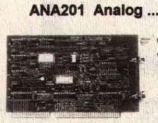
ANA150 Analog/Counter... $ 89

* 8 Channel 8-Bit 0 to 5 Volt input
* 3 16-Bit Counters
* 400KHz Sampling

DIG200 Counter I/O ..... $ 79

* 3 16-Bit Counters
* 8 TTL Input lines
* 8 TTL Output lines
* Selectable Clock Frequency input

ANA200 Analog I/O ..... $ 79

* 1 Channel 12-Bit 0 to 5 Volt input optional bi-polar
* 100KHz / 300KHz Sampling rate
* 24 TTL I/O lines

ANA201 Analog ..... $ 119

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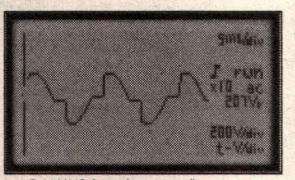
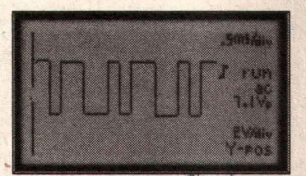
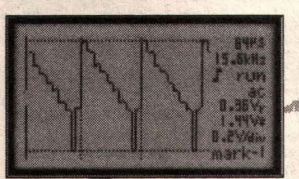


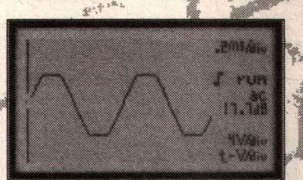
AC MAINS (e.g. phase control)



DIGITAL SIGNALS (e.g. pulse train)



TV AND VIDEO (e.g. composite video signal)

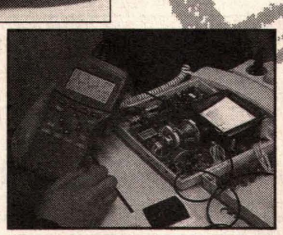


AUDIO SIGNALS (e.g. amplifier output clipping level)

SPECIFICATIONS:
- Maximum sample rate: 5MHz
- Input amplifier bandwidth: 1MHz (-3dB at 1V/div setting) 1Mohm //20pF (standard probe)
- Vertical resolution: 8 bit (6 bit on LCD)
- LCD Graphics: 64 x 128pixels
- dBm measurements: From -73dB tot +40dB (up to 60dB with X10 probe) ±0.5dB
- True rms AC measurement: 0.1mV to 80V (400Vrms with X10 probe) 2.5% accuracy
- Time base: 20s to 2µs / div in 22 steps
- Input sensitivity range: 5mV to 20V/div in 12 steps (up to 200V/div with X10 probe)
- Supply voltage: 9VDC / min 300mA adapter
- Batteries (in option): Alkaline type AA (5 pcs required)
  NiCd/NiMH rechargeable
- Battery life: Up to 20 hours with Alkaline batteries
- Safety: Meets IEC1010-1 600V CATII, pollution degree 1
- Dimensions: 105 x 220 x 35mm (4.13"x7.95"x1.38")
- Weight: 395g (14oz.) (excl. batteries)

OPTIONS:
- Insulated measurement probe x1 / x10: PROBE60S
- Adaptor for 110VAC: PS905USA

$199.95
Probe not included



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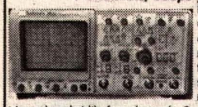
CIRCLE 275 ON FREE INFORMATION CARD

350MHz, TEKTRONIX 2467, MICRO CHANNEL PLATE CRT! 4 Channels, 500ps per div. in normal room light.



Displays intermittent variations as they happen. Captures the slowest one shot events with 4ns per division a 100 fold increase in the visual writing rate over conventional CRT. Features: 1 ns rise time, 500ps/Div time base, 2mV/Div. vertical sensitivity at 350MHz, 20ps time interval resolution, 1Mohm / 50-ohm input, 500Mhz trigger bandwidth, four channels. On-screen waveform cursors provide vertical & horizontal scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication. Complete with 2 probes, pouch, and manual. Mint cond. 90 day warranty. **New.....$12K Now TEK2467.....$3250.**

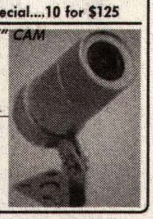
MAGNETIC STRIPE READER, with BAR CODE WAND.

New, from United Barcode industries, MAGSCAN model 1P0-155000-14-01 on-line magnetic stripe and BAR CODE reader designed for compactness and flexibility. The Magscan connects to the keyboard port via the standard mini-DIN connector. Perfect for use with a laptop. A good reed is indicated by an audible beep and a visual signal from its LED. The unit reads track 1, track 2, or track 1 & 2. No software is required. Simply plug it in and start scanning/reading. Very compact: 5"L x 2"W x 1.5"H. No external power is required. 60 page manual included with complete user configuration info. (Done using the wand!) One manual per order. A super hacker device. **SPECIAL...$49ea. or 2 for $79**

MINIATURE and, PRECISE, PORTESCAP, SWISS, GEARMOTOR.

State of the art "ironless" type, mini motor type M11-210-54-0 with approx: 40:1 gearbox. Size: 16mm d. x 43mm L Operating parameters: @6VDC input, 8mA, 141RPM No Load, @ 12VDC input, 12mA 290RPM No Load **PORTESCAP, TYPE B: $15ea. 2 for $27, Special....10 for $125**

ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAM



Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mmdX50mm, 36" cable with BNC video & DC barrel jack.

GM-200K, PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 once! Size only 23mm d.x35mm long. Think of the places you could put this little jewel.

GM-200K-STD.....$99
GM-200K-PH lens.....$99

WORLDS SMALLEST ••• 100mW ••• VIDEO TRANSMITTER, ON SALE

Incredibly only 0.9" x 0.8" x 0.37" Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been wailing for. **Shown actual size.** Smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV included. Perfect with our GM1000A. Both will fit in a cig. pack with battery!

SPECIAL TVX-100.$159. with GM1000A CAM....$209.

TORROIDAL, ISOLATION, STEP DOWN TRANSFORMER

Nicely made ULVECO,USA model 22432. Thermally protected. Primary is 0-120VAC, Secondary is: 0-120V@ 500VA and 18V @50VA Includes heavy duty mounting bracket. Size: 5/12" Diam. x 2.75" Thick. Weighs in at: 10.5 Pounds. **ULVECO XFMR.....$20ea.**

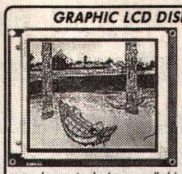
NEW! 0.008lux, COLOR NIGHT VISION CAMERA! UNBELIEVABLE LOW LIGHT PERFORMANCE. Our GMV-2K, DOES it in COLOR TOO!

For covert, millitary & scientific applications that must be color, this is it. Performance is enhanced through low speed electronic shuttering and digital frame memory. With the optional, auto iris lens, 24 hour monitoring is possible. Auto sensitivity mode starts as it becomes dark. Eight Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64, X128. These provide frame rates of 60, 15, 8, 4, 3, 2, 1, and 0.5 per second. Auto/Man. white balance. Alum. housing, dual 1/4x20 mtg. Specs: 1/3" CCD, with 291K pixels, 320 Lines, 12VDC @200mA, Std. video out on BNC. Size: 54mmx50mmx94mm long. With pwr. adapter. All functions can be externally controlled via an 8 pin mini DIN. Use std. c-mnt lens not incl. **GMV2K...$589ea.**

OPT. 4mm, f1.4 A/I lens w/cable $119

CLOCK RADIO, COVERT CAMERA, New, Magnavox clock radio with covert low light video camera. Specifications per our GM1000A shown on page one. Connect the output to anything with a "video Input" jack. via RCA style ouput. **SPECIAL,CRC-1-STD,.....$119.ea**

GRAPHIC LCD DISPLAY, SEIKO Model G191C21R0A0



Like new, G191 series, monochrome with E/L (electroluminescent) backlight. These gorgeous FSTN type panels are perfect for direct sunlight applications. They won't wash out! The dot format is 192 X 128. The module size is 98 x 86 x 13.4mm. The viewing area is 78 x 54mm. the dot size is 0.33mm x 0.33mm. Power requirements are +5VDC @ 3.1mA and -12.4VDC @ 2.9mA. The backlight adds 120mA to the +5 current. Weight is 3.6oz. The viewing angle is 40°. Operating temperature range 0°C to 50°C. Now's your chance to design a really high-tech display into your next project. Data included. These are sophisticated devices, please be sure you are capable of integrating them into your device. Please review data at Seiko web page: www.seiko-usa-eed.com/lcd/html/graphic/modules/g191c21r0a0.html. All sales final. Current price $111 each. Very Limited quantity. **SPECIAL.....$29ea. or 2 for $49 or 5 for $99**

PARKER-COMPUMOTOR, SM231A BRUSHLESS SERVO MOTOR

New, SM series with optical encoder feedback. (1000PPR) Rated shaft output power is 205 watts. Stall current is 2.1 Amps. Rated speed is 7500RPM, Torque at rated speed: 2.37 lb.-in., Shaft diameter: 0.25". Full specs are available on the web at: WWW.compumotor.com/catalog/SMseries598.pdf. Size: 4"L x 3.3"H x 2.25"W. These are sure to sell out. Very limited quantity. **SPECIAL.....$149ea. or 2 for $269**

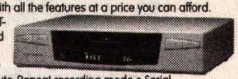
BIO CHEM VALVE CORP.

Type:100P2-S50, Solenoid check valve. This unique valve has no contact with the controlled substance. It operates be squeezing a 1/8" diam. tubing and thereby "crimping" it closed when activated by 24VDC. The action is normally open. (shown right) Size: 1" diam. x 2.6" L. With 12"L wire leads. Removed from equip.

PREDYNE, MINI VALVE, Type A92037-926, 24VDC @200mA solenoid operated, 5/32" orifice, 8PSI, pass through valve with 1/8" barbed nylon fittings attached. (removeable for screw in connection.) 12" wire leads. (shown left) Removed from equip. Both are like new condition.

BIO CHEM VALVE.....$5ea., PREDYNE VALVE.....$6ea.

NEW, GM960 TIME LAPSE VIDEO RECORDER



Finally a brand new, 4 head, T/L recorder with all the features at a price you can afford. Features: • Up to 960 hours on a standard T-120 VHS tape.• 12 different modes for record and playback • Audio recording in the 12H and 24H mode. • 30Day memory backup • Easy mode setting.• On- screen menus • Auto-Repeat recording mode • Serial or One-shot recording • Time, Date, speed, and Alarm indicators on screen. These deluxe units are front loading and are 14"W x 3.5"H x 12.2"D, 110VAC powered. **SPECIAL.....$699ea. or 2 for $1349**

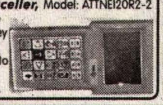
STEPPER DRIVERS, SUPERIOR ELECTRIC, SLO-SYN Type, 3180-PT125,

These drivers are removed from equipment and in good condition. They are designed for use with an external indexer. We have no documentation for these units. They are a compact 7"x5"x4". We always sell out of these so don't delay.Verylimited quantity. **NOW.....$139ea. or 2 for $249**

PORTABLE MINI PRINTER, 40 COLUMN, with INTERNAL NI-CAD POWER!

The model SD222-1000 is a NEW and very cool, self contained, alphanumeric, impact type printer. It features a standard parallel port and an internal Ni-Cad power supply. Can also be powered via the 9VDC power adapter supplied. Uses standard 2" wide paper rolls available everywhere. Has self test function and diagnostic mode. Can emulate Epson and Citizen 560. It will print from the LPT port of your PC. Very rugged and well made. Perfect for any remote printing or data logging application. Size: 8"L x 4.1"W x 3.5"H. **OUR PRICE.....$49ea. or 2 for $75**

"A STRANGE LITTLE DEVICE"



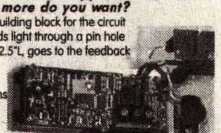
AT&T Universal Digital Echo Canceller, Model: ATTNEI20R2-2 If you have a use for this you know they are quite pricey. We have several available. They are like new. Standard 6pin RJ style jack for connection. Give us a call if you know how to use this and get one for free. **AT&T, UDEC.....$89ea.**

NEWPORT TRANSLATION STAGES. also a few other goodies too!

MODEL:	DESCRIPTION:	EACH
270	LAB JACK	$249
RSA-2T	360 deg. Rotary Stage with Clear Aperture.	$129
625A-4	Laser Holder	$149
481A	Rotary Stage	$189
M36	Translation Stage	$249
460A-XY	X-Y Translation Stage	$189
M37	3 Axis Trans. Stage	$289
415	Vertical Trans. Stage	$129
M360-90	Mnting. Plate 90deg.	$ 29
M436	Translation Stage	$199
M150	Magnetic Mtg. Base	$129
420	Linear Trans. Stage	$119
HP10703A	INTERFEROMETER	$129
HP10702A	INTERFEROMETER	$129
HP10780A	RECEIVER	$199
RUCKER & KOLLS 222	X-Y-Z Micro Positioner	$ 50

10V @ 2.5 AH SEALED, LEAD ACID, PACK. Each pack has 5, 2 Volt cells. "D"size cells are arranged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Perfect for high drain applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D **SALE! 6-five packs for $20, 40 for $99**

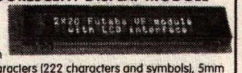
OPTICAL EXPERIMENTERS DELIGHT, Light Source, Fibre Optics, Two Detectors, Four Bandpass Filters, Stepper Motor, A/D Converter..... What more do you want?



We are sure this would make an interesting building block for the circuit savvy among you. A precision mini lamp sends light through a pin hole to illuminate a bifurcated F.O. cable. One leg, 2.5"L, goes to the feedback detector, presumably to compensate for any change in the source intensity. The other leg, 12"L terminates at a mini convex projection lens and illuminates an unknown item under scrutiny. Light passing through the subject matter is gathered by another mini lens and directed to a 2" diameter filter wheel with 4 1/2" diam. bandpass fillers with pass wavelengths of: 409nm, 450nm, 490nm and 630nm, individually selected with the help of a mini stepper motor and gears. Light passing through the fillers is detected via a large area photo diode whose output is presumably passed to the a/d converter (ADI 7533KR) and the rest of the surface mount components. Very nicely made, shielded and supported on an intricate aluminum extrusion. (black anodized.) Overall size of the assembly is 5.6"L x 2"W x 8.5"H. Now you know what we know. Must have cost a bundle. Our price, less than the cost of one bandpass filter.

SUPER EXPERIMENTERS SPECIAL.....$39ea.

FUTABA, 2X20 VACUUM FLUORESCENT DISPLAY MODULE

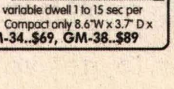


New or like new, model M202SD series. Can directly replace LCD displays. The module includes the VFD, microcomputer and driver. Connects directly to the system bus. Display up to 40 dot matrix, 5 x 7 characters (222 characters and symbols), 5mm H x 3.5mm W with cursor. Display color is green at 505nm. Brightness is 690 cd/m² with four level dimming function. Weight: 5 oz. Size: 6.7"L x 2.6"H x 1" thick. Power required is 5VDC @ 350mA. Serial or parallel interface selectable. Perfect for any high visibility display requirement. With data. **SPECIAL FUTABA.....$15ea. 3 for $39**

DAYLIGHT/LOW LIGHT MINI CAM & A/I LENS,

For dawn 'till dusk applications. Rugged alum. housing, dual mtg. sockets. 1/3" CCD, 420 lines res., 0.1 lux sens., AGC, 12VDC @120mA. Take full advantage of camera sensitivity with super, 4mm, f1.4, 78° FOV Auto Iris lens included. BNC video out. 50mm sq. X 65mmL. With pwr. adapt. **SPECIAL, GM-510A/I...$189 or 2/$349**

NEW! 4 or 8 CHANNEL, SEQUENCER



Model GM34 or GM38. Connect to any four standard video signals and they will be sequentially output to the dual rear panel BNC outputs. Front panel user adjustable, variable dwell 1 to 15 sec per channel. Auto or manual switching with channel bypass. Compact only 8.6"W x 3.7" D x 1.75" H, ac powered. Video loop through. **Special, GM-34..$69, GM-38..$89**

SUPER, MINI C-MOUNT CAMERAS, Super sensitive, GM410 or the general purpose GM412,

The GM-412 specs: B&W, size 1.5"sq. X 2.4"L, 250,000 Pixels, 380 Lines Resolution, Sensitivity 0.3 Lux, The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX., Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform *ANY* camera in this magazine. Multi-lens options are available to exploit their superior performance.GM412 shown bottom. GM410 shown top.

GM412, less lens..$119, GM410, less lens..$169

low cost MICRO CAMERAS, w/audio

1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 4mm, 78° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 ounce! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. PH is 0.6"d, 1.6M long wiring harness with connectors included. **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

GM-1000A-STD.....$59 GM-1000A-STD/Aud.....$64
GM-1000A-PH.....$59 GM-1000A-PH/Aud.....$64
GM-1000A-CMNT..$59 GM-1000A-CMNT/Aud.$64

Micro Lenses for GM1000 series

2.5mm, 150°.....$22	8.0mm, f2.0.....$22
4.3mm, 78° f1.8.....$22	12.0mm, f2.0.....$22
6.0mm, f2.0.....$22	5mm, 70°PH.....$22

C-MOUNT LENSES

LOW LIGHT	STANDARD
16mm, f1.6, 15° FOV $39	4mm, 80° FOV $24
8mm, f1.3, 40° FOV $49	8mm, 40° FOV $24
4mm, f1.4, 78° FOV $49	12mm, 28° FOV $24

Please fax us your list of unique surplus material.

MOTORIZED ZOOM LENS SPECIAL 6X magnification, 12X on a 1/3" camera! Auto iris too!

New, fabulous hi-res. optics with std. C-Mount. Superior Fujinon and Vicon lenses. Normally cost from $600 to $1500. There is no substitute for a good lens! All drive motors will operate from 6-12VDC. Auto iris has a built in amp which works with any cameras video output for control.

Type B-6, 12.5 to 75mm, 6X, f1.2 ..... $179 or 2 for $349
ZOOM LENS CONTROLLER, NEW $169

MINI ROTARY DRIVE with on board LINEAR SLIDE,

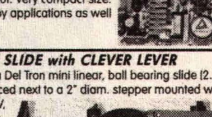
Provides 300° rotation between removeable stop. Rotates continuously with-out stop. 2 optical position sensors for start & end. Same stepper as above. Each full step = ~0.25° of rotation. Made from cast & machined resin & alum. Attached slide provides 3" travel. Construction similar to slide above. Moves 0.008" per step. Dual optical end of travel sensors. Overall: 7.5"L x 5.25"W x 4.5"H. **MRD-1....$39 or 2/$69**

NEW, TRIPLE OUTPUT, 60W, POWER SUPPLY

Astec model: SA40-1313, outputs of +12VDC @ 3Amps, +5V @ 5Amps and -12V @ 350mA. 110VAC input. Very compact size: 3"W x 5"L x 1.3"H Perfect for many hobby applications as well as an external disk drive power supply. **SPECIAL.....$5ea. or 5 for $20**

DEL TRON LINEAR SLIDE with CLEVER LEVER

An interesting assembly, consisting of a Del Tron mini linear, ball bearing slide (2.5"L x 1"W x 0.56"H) with 2" travel. Slide is placed next to a 2" diam. stepper mounted wheel. A 1.5" sq., Four wire stepper, rated at 4V, 0.95A, 1.8°/step. The bottom side of the wheel acts as a cam with roller and moves a spring loaded arm (3.4"L x 1"W) up and down 1/2". All components, including an optical end of travel detector are mounted on precision machined, 0.2" thick, black anodized aluminum. Overall size: 8.5"L x 3."D x 2.5"H.Ex. Cond. Ltd. Qty. **DelTron-W.....$39ea.**



COMPACT, THK, LINEAR SLIDE with STEPPER DRIVE,

A really slick, super precision, THK LWL-12 series, recirculating ball slide with a 3.6" long toothed rack (14TPI) mounted next to the rail. The rack mates with a 0.6"diam. nylon drive gear mounted to a compact, (1.5" sq.), Four wire stepper, rated at 4V, 0.95A, 1.8°/step. One full step moves the slide approx. 0.050". All components, including an optical end of travel detector are mounted on precision machined, 0.2" thick, black anodized aluminum. Overall size: 5.5"W x 3.3"D x 3.4"H. The system provides 3.1" of extremely rigid travel. Ex. cond. Ltd. Qty. **LS-LWL-12....49ea.**

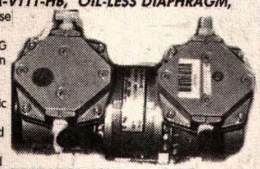
CIRCLE 246 ON FREE INFORMATION CARD

GENERAL SCANNING, TYPE M3, CLOSED LOOP, GALVANOMETER, LASER SCANNER.

Innovative motor design coupled with an advanced capacitive position detector, provides high speed, wide angle and improved stability. Using moving magnet technology this scanner provides low inertial, rigidity and low inductance. Specs. include, +/-30° excursion, wobble: 1.5urad., Repeatability: 2urad.,Coil Res.: 4.8 Ohms, Peak current: 10Amps, Angular sensor sens.: 8.1uA/o. A high quality galvo for demanding laser displays. Galvo only you provide the drivers. Very limited quantity.

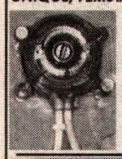
M3 GALVO....$369ea. or $699 for a pair.

VACUUM PUMP, GAST, MAA-V111-HB, OIL-LESS DIAPHRAGM,



Self contained, rugged & long life. These 2-stage pumps operate on 115VAC @ 1.7Amps. The pump provides 28 IN.HG of maximum vacuum at 0.47CFM open flow. Pump weighs 9 pounds. Perfect for commercial and industrial applications, such as agitators, graphic arts, business machines and laboratory use. Permanently lubricated and maintenance free. Like new, removed from equipment. Very limited quantity. **Reg. >$200, Our price, GAST, V111....$89ea. or 169 for a pair.**

UNIQUE, PERISTALTIC PUMP from COLE PALMER, Model 7016-20



Heavy duty cast polycarbonate construction. Supplied with flex shaft coupler for 1/4" drive shaft. You supply the motor. These pumps are self priming, valveless and non clogging. Tubing pumps are designed for inert pumping of chemicals in such applications as food processing, caustic liquids, pool and spa chemicals, metering and high viscosity liquids. Fluids contact only the tubing, rollers move fluid through the 1/4"O.D. x 1/8"I.D. tube. Estimated flow rate is 0.4 GPH or approx. 20CC / min. Size: 3" x 3.5" x 3.3"H. Excellent condition, removed from equipment.

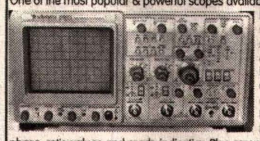
PERIS PUMP.....$29ea. or 2 for $49

NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN' (down 60 ft.) UNDERWATER B&W CAMERA with INTERNAL, INFRA-RED ILLUMINATOR!

Sleek black anodized, BRASS, housing. O-Ring sealed & WATERPROOF. Adjustable mount incl. Specs: 1/3" CCD, 400 Lines res., 0.05 Lux sensitivity, AGC, Auto Shutter. 12VDC @225mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable, Perfect as a remote area inspection camera. Great for general outdoor use as well. **GM-300KIR.....$199**

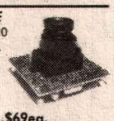
TEKTRONIX 2465-DM, 4 Chan., 300MHz, O'Scope, on screen waveform stats & DMM READOUT

One of the most popular & powerful scopes available at a reasonable cost.



Features: 500ps/Div sweep, 2mV/Div. vertical sensitivity, 1Mohm / 50-ohm input, 500Mhz trigger bandwidth, four channels. On-screen waveform cursors provide vert. & horiz. scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication.Plus complete DMM ! Complete with 2 probes, and manual. Excellent condition. 90 day warranty. **$2295.**

MICRO CAMERA, with MIRROR IMAGE



Perfect for "rear view." 1/3" CCD, with 266K Pixels. 410 Lines Res., 0.3 Lux sens. AGC and Auto/Man Shutter. Low Power 12VDC @100mA 3.6mm, 92° FOV, focus from 10mm to infinity. A real glass lens! WHY BUY DISCONTINUED OR SURPLUS? New first quality Standard NTSC video out. 1/2 once! IR SENSITIVE!

GM251, with AC power adapter.....$69ea.

MOTORIZED LINEAR SLIDE, offers 0.001" per step travel.

A THK, LWL-12 series re-circulating, ball bearing slide with a 4.7" long steel rail is mounted to a 0.2" thick, black anodized, aluminum plate. The slide has a right angle bracket attached to a spring loaded, anti backlash, drive nut. Riding on a 0.37"diam. 10TPI lead screw which is coupled to one end of a dual 1/4" shaft , stepper motor with specs: 1.8° /step, 5V @1Amp, 4 wire. One optical end of travel sensor is also in place. Ex. Cond. Ltd. Qty. **LWL12-2.5adapter.....$59ea.**

MOTORIZED LINEAR SLIDE, Provides precise fluid metering up to 1.0ml in 0.01ml steps! As well as 2.5" of 0.001" per step travel.

A precision dual port (in and out) syringe assembly with a 1.0ml capacity is mounted to the flip side of (photo above) THK, LWL-12 series re-circulationg, ball bearing slide with a 4.7" long steel rail is mounted to a 0.2" thick, black anodized, aluminum plate. The slide has a right angle bracket attached to a spring loaded, anti backlash, drive nut. Riding on a 0.37"diam. 10TPI lead screw which is coupled to one end of a dual 1/4" shaft , stepper motor with specs: 1.8° /step, 5V@1Amp, 4 wire. Optical end of travel sensor is also in place. Excellent condition. Ltd. Qty. **LWL12-SYR.....$69ea. 2/$129**

EXTREMELY HIGH VOLTAGE POWER SUPPLIES UP TO 180KV !

- GLASSMAN, 0 to 180KVDC @ 5mA, with high voltage stack. HV driver is rack size. Like new condition. **GLASSMAN, 180KV Supply w Stack,...$1495ea.**
- ELECTRONIC MEASUREMENTS INC./ ALE-4060, 0 to 60KVDC @ 100mA, Brand new in original boxes. High voltage driver and voltage multiplier in two separate units. p-p ripple 40 V full load. External programming voltage 0-10VDC, Output V & I monitors, 0-10VDC **EMC/ALE-4060, 0-60KV Supply,.....$1850ea.**
- Kaiser Systems, model 51-40-12, A state of the art, rack mount with digital readout. Provides 0 to -40KVDC @ up to 12.5mA. Like new. **KAISER SYSTEMS, -40KVDC Supply.....$895ea.**
- TREK-678, 0 to -30KVDC ,high voltage , high speed "amplifier" provides high voltage output which follows a 0-10VDC control voltage with fast response and settling time. Rack size. Like new. **TREK- 678, -30KV Supply/Amplifier.....$995ea.**
- TREK-676, 0-20KVDC ,high voltage , high speed "amplifier" provides high voltage output which follows a 0-10VDC control voltage with fast response and settling time. Rack size. Like new. **TREK- 676, -20KV Supply/Amplifier.....$895ea.**
- GLASSMAN, 0 to -20KVDC @ 20mA, rack size. Model: PS/WX20N50, Excellent condition. **GLASSMAN, -20KV Supply,.....$795ea.**
- DELL ELECTRONICS, model 2.5-10-1A, 0 to 2.5KVDC @ 10mA, provides negative output as supplied but can be modified for positive output. Excellent condition. **DELL-2.5-10-1A, -2.5KV supply,.....$59ea.**

HIGH VOLTAGE MULTIPLIER STACKS, 200,000 VOLTS, PLUS! From Farnum, Wallis or Glassman Excellent condition.....$495ea.

SMOOTH AS SILK, Dual Axis, MOTORIZED LINEAR SLIDES, Provide a 9" x 4.3" work envelope.

Dual, THK, LWL-12 series recirculating, ball bearing slides, one with a 6.1" long rail and the other with an 11.5" rail are mounted to each other via a cast, 0.2" thick, black anodized, aluminum 90° bracket. Slide motion os provided via an 8 tooth per inch belt drive mounted to each rail and powered by independent stepper motors. The long axis uses a 2.2" diam. size 23, 1.80° per step, 5V@1Amp, 4 wire stepper while the short axis uses a 1.5" sq., 1.8° per step, 4V@1Amp, 4 wire stepper. Each full step of either motor provides approx. 0.025" travel of the slide. One optical end of travel sensor is attached to the short axis. Can be easily separated for use as two separate drives. Excellent condition. Very limited quantity. **Special, DUAL-LWL1.....$99ea.**

NEW, "STEALTH CAM", MICRO SIZE, with AUDIO!

The sleek aluminum housing fits like a glove! Removeable mtg. bracket & a 1.3M cable with BNC vid., RCA aud., (internal mic) & DC pwr. jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM"•1/3" CCD •410 Lines•0.3 Lux• AGC•Auto Shutter•Pwr. 12V @110mA•250k pixels•Std. 4mm, 78° FOV lens•Pinhole, 90° FOV•Focus:10mm to Inf.•NTSC video•<ounce!•IR SENSITIVE•Size Std: 30mm sq. x 29mm d. PH: 16mm d. Don't confuse with LOW RES., HIGH LUX C-MOS CAMERAS.

GM-2000S-STD OR PH, w/aud., ...$79.00

UNUSUAL, DUAL ROTARY MOTION TABLE offers 2 independent drives with 0.02° per step!

A heavy duty, 23"L x 15.25"W x 5/8" thick, black anodized alum. panel serves as the base for two concentrically aligned, rotary motion units. The outer, "platter" is 13" d x 0.1" thick blk. anodized alum. Drive is via a toothed belt & direct coupled 3.2" toothed pulley, driven by a stepper mounted 1/2"diam. pulley. Stepper is: 2.2° d, size 23, 1.8° /step, 5V@1Amp, 4 wire. The inner "platter" sits 2.7" above the 13" platter. Its' outer diameter is 4". An additional raised center section of 2" diam. elevated 1" above the 4" diam. can act as a "hub" The inner platter drive is via a toothed belt & direct coupled 3." toothed pulley, driven by a stepper mounted 1/2"diam. pulley. Stepper is: 1.5° sq., 1.8° /step, 4V@1Amp, 4 wire. Steppers are fully independent allowing. The large base provides the perfect area to "breadboard" your mechanical marvel. Excellent condition.

DUAL PLATTER .....$69ea. or 2 / $119

HAPPY HOLIDAYS!

RESOURCES UN-LTD.

VISA, MC, AMEX, DISCOVER, COD.
ORDER: 800-810-4070 TECH: 603-668-2499
FAX: 603-644-7825 E-MAIL unltd4u@m20.net
300 BEDFORD STREET , MANCHESTER, NH 03101

NEW, 2.4GHz VIDEO+STEREO AUDIO TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.

Originally sold for $500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tilting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. (1" to infinity, macro capable) Auto power off when the privacy shutter is closed. Power is 7-13VDC. (all pwr. adapters and cables included) 1/3" CCD, 330Lines res. 35% better than standard VHS! Can als be used to transmit VCR oputput to another TV for remote viewing.

SONY-ASTROVIEW COMBO..$189ea. or 2/$339
2.4GHz TRANSMITTER & RECEIVER.....$129 pair.
SONY COLOR CAMERA with AUDIO.....$69ea.

NEW! LCD COLOR, TFT, ACTIVE MATRIX DISPLAY offers 5.6" VIEWABLE AREA.

You asked for it. Finally we found a unit with exceptional quality at an affordable price. Perfect as a portable, general purpose color monitor for standard NTSC color or B&W video systems. Fully compatible with all our cameras as well as Camcorder, VCR's etc. Perfect as a rear view system with any video camera by virtue of its built in, mirror image function. Completely enclosed unit has adjustments for color, contrast and brightness and a volume control for it's internal stereo speakers! Also has a std. 1/4 x 20 Tripod socket and a tilt down stand for table top viewing. Inputs include: audio (L&R) and video on std. 1/8" mini jacks. External 12VDC on std. barrel connector. Specifications: 5.6", TFT active matrix LCD with 76.8K Pixels, CCFL backlight with 270cd/m Luminance, 500mW audio output available on std. 1/8" jack. 12V@600mA powered, 50mV min. or std. line level audio input. Overall size: 6.4"W x 5.25"H x 2.2D" New first quality. An optional accessory kit is available which includes: A luggage quality, custom made, ballistic nylon, padded case with dual removable straps for shoulder and/or holding at waist level for portable, hands free viewing. Built into bottom of case is 'AA' battery holder for internal power pack. (less batteries) Also supplied is a complete set of A/V cables and adapters with remote power switch. **GM-TFT56, with AC power adapter.....$289ea.**
GM-ACCYTFT.....$25

MINI- BAR CODE SCANNER from SYMBOL TECHNOLOGIES,

Like new, removed from equipment. Symbol model: LS-6820 series. A complete 650nm, laser diode based, high speed scanner that fits in the palm of your hand. Lots of goodies inside. Supplied with pinout and power supply data for std. connector. Operates on approx. 6VDC @ 100mA, Sold as an experimenters item only. No add'l. tech. support available. Limited quantity. **LS-6820,...$39ea. 2 / $69**

NEW GM182, 580 LINE, CCD CAMERA,

1/3" CCD, 580 Lines Res., 0.1 Lux sens., AGC, Auto Shutter. Pwr. 12VDC @120mA, 3.6mm, 71° FOV, Real glass lens. Focus from 10mm to infinity. Standard NTSC video out. 1/2 once! SENSITIVE to IR. Size: 1.7"sq. x 1"d. with 6" leads. 12VDC Power adapter included. Superior performance. **GM182, SPECIAL $159ea.**

END FIELD of VIEW GUESSWORK! 3.5 to 8mm VARI-FOCAL LENS

Brand New, super f1.8 lens allows you to smoothly adjust from a 97 ° FOV @ 3.5mm to a 44° FOV @ 8mm. Now you can frame your area of interest just the way you want it! Standard CS-Mount with adjustable focus and iris.

SPECIAL.....$89ea. or 2 for $169

NEW! GM-7M, HI RES., 600 LINE, 7" MINI MONITOR perfect for rear view system or other DC power applications.

NEW! GM-7M, B&W video monitor. Can be operated from 11V to 32VDC. @ 1.5Amps. These deluxe units feature: • Automatic rear sense line. Turns system on when vehicle put into reverse • Automatic dimmer for night operation • adjustable brightness and a volume control for it's internal stereo speakers! Also has a std. 1/4 x 20 Tripod socket and a tilt down stand for table top viewing. Inputs include: audio (L&R) and video on std. 1/8" mini jacks. External 12VDC on std. barrel connector. Specifications: 5.6", TFT active matrix LCD with 76.8K Pixels, CCFL backlight with 270cd/m Luminance, 500mW audio output available on std. 1/8" jack. 12V@600mA powered, 50mV min. or std. line level audio input. Overall size: 6.4"W x 5.25"H x 2.2D" New first quality. An optional accessory kit is available which includes: A luggage quality, custom made, ballistic nylon, padded case with dual removable straps for shoulder and/or holding at waist level for portable, hands free viewing. Built into bottom of case is 'AA' battery holder for internal power pack. (less batteries) Also supplied is a complete set of A/V cables and adapters with remote power switch. **GM-TFT56, with AC power adapter.....$289ea.**
GM-ACCYTFT.....$25

$5000 HI-TECH SURVEILLANCE SYSTEM, NOW 83% OFF!

THIS SUPER SYSTEM INCLUDES:
- **MOTORIZED, 6X ZOOM LENS**
- **MOTORIZED, 360 ° PAN**
- **MOTORIZED, TILT up to 90°**
- **PHILIPS HIGH RES. 1/2" CCD CAM.**
- **OPAQUE BLACK INNER DOME**
- **CLEAR ACRYLIC OUTER DOME**
- **ZOOM LENS CONTROLLER with A/I**
- **PAN and TILT CONTROLLER**

Walk into any major department store and you will see these fully integrated systems. Manufactured by Sensormatic, the same company who supplied the Atlanta Olympics! These are late model, new in the box systems. Virtually ready to use. All you add is power and cable.A quality Philips, 1/2", B&W CCD camera provides 450 lines resolution and 0.5 Lux sensitivity! Anodized aluminum construction. Camera plus Pan & Tilt are powered by external 24VAC via the included Pan & Tilt controller. Super 6X, f1.2 motorized, Zoom, Focus and iris lens provides the capability of "close up" inspections. Zoom lens controller with auto iris control included. Size of dome: 14"diam. includes mounting kit for drop ceiling installation. Sensormatic price $5000ea.

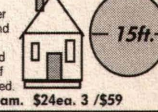
COMPLETE SYSTEM SPECIAL....$849ea. or 2 for $1599

6V@12AH SEALED, RECHARGEABLE, BATTERY

New Panasonic, LCR6V12PI. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9"L x 3.7"H x 1.9"D

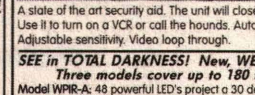
2 for $20, 10 for $89

GIANT WEATHER BALLOONS, Real military surplus,



Black latex meteorological instrument balloons. 3 ft., 3/4 pound lift, or the monster >15ft. model with attached shock absorbing section and internal ball stopper at fill port 0.0035" thick latex. Manufacturers individual packages. A rare find. Limited Quantity. Please note we recommend filling only to half max size as they are extremely fragile when fully inflated. Instructions included. **3ft. diam. 2 /$15, 15ft. diam. $24ea. 3 /$59**

Brand New, Video Motion Sensor.



Model VM10. Attach to any standard video signal and you've got an electronic "watchman" diligeniily watching the enfire scene. Or any adjustable sized area within the scene. Such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. Adjustable sensitivity. Video loop through. **NEW, VM10.....$189ea.**

SEE in TOTAL DARKNESS! New, WEATHER PROOF IR FLOODs, Three models cover up to 180 feet!

Model WPIR-A: 48 powerful LED's project a 30 deg. FOV beam up to 45 feet.
Model WPIR-B: With the same external package and dimensions as the A model providing over 250% more illumination distance; up to 120 feet! The B model utilizes a Quartz Halogen lamp with a 10° beam spread and a custom made bandpass filter of approx 840nm-1200nm.
Model WPIR-C: Provides illumination up to 180 feet. The C model utilizes a Quartz Halogen lamp with a 30° beam spread and a custom made bandpass filter of approx 840nm-1200nm. Features common to all 3 models include: CDS controlled automatic on at dusk off at dawn! 110VAC power. Rugged anodized aluminum, housing with adjustable mounting bracket Size for the Type A & B: 4"x5"x6.3"L and for the type C: 13.4"L x 7"H x 7.1"W. Weight for A or B is: 3.5lbs. Weight for C is: 10lbs. All commercially made and brand new!

WPIR-A/45ft...$169. WPIR-B/120ft...$229. WPIR-C/180ft...$359.

All floods achieve excellent performance with the GM-410 shown on the previous page. Only $149 with the purchase of an IR Flood!

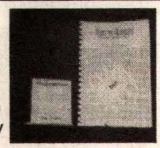
PIC and ATMEL micros in Basic !

New programmer Picstart Replacement with 40pin zif!

WOW!

PIC n Basic $59.95

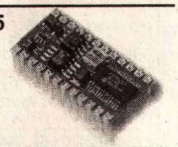
Program Pics in Basic! Pic n Basic compiler converts your BASIC program to files that can be used to program the Pic micro. Pic n Basic allows you to use true basic stamp I/II libraries on an ordinary Pic instead of expensive stamps. Pic n Basic is more powerfull and straight forward than anything else like it.



PIC n Basic Pro $199.95

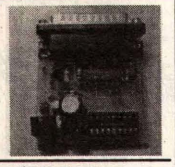
Stamp Replacement $29.95

The Stamp replacement allows you to use an ordinary Pic 16F84 to replace the Basic Stamp II. Pin for Pin Compatible. 4x Times faster using Pic n Basic!



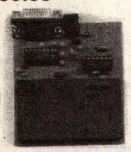
PIC Easy Programer $39.95

The PIC Easy is a low cost Pic Programmer. It will program all the most popular Pic chips See website for list of Pics. Software and instructions included.



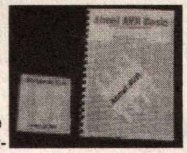
ISO Smart Card Programmer $59.95

Now you can read & write to smart cards. Develop your own smart card security systems. Build smart cards using Pics and AVR's or you can adapt ready made smart cards. You can now explore the smart card world! Programmer will read and write to all ISO 7816 compliant cards.



ATMEL AVR Basic Pro $99.00

Program the Powerful ATMEL AVR's in Basic. The AVR's are 25X faster than Pics and now you can program them in Basic. With one AVR you can have up to 32 lines of I/O plus the AVR can handle direct RS-232 serial port with special built-in ports. See website for details on the AVR's.



ATMEL AVR Prototyping Boards $24.95

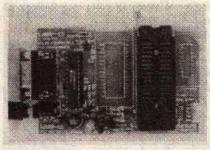
Get AVR projects up and running in a Flash! Houses the ATMEL AVR and all needed parts for operation plus a large prototyping area for your projects. Comes with a socketed ATMEL AVR AT90S8515!

Need a more powerfull chip?

Try the ATMEL AVR

PIC & AVR Pro Programmer $99.00

The ALLPIC will program almost all Pics without optional adapters! Includes 40 pin zif Socket. Plus it will program Atmel AVR's. Free upgrades for New Chips! See website for list of chips. MLAB compatible. Direct Picstart replacement Includes software and manual.



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Outside the US **1-248-473-1182**

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Visit us on the web at www.worldwyde.com

21365 Randall St. Farmington Hills, MI 48336

Combo Deals

Pic n Basic and Pic Easy Programmer Combo #1.....$89.95

Pic n Basic with Pic Easy Programmer and stamp replacement Combo #2.....$109.95

ATMEL AVR Basic Pro and the ALLPIC & AVR Pro Programmer w/40 pin Zif Combo #3.....$179.95

Both Pic and ATMEL Basic with ALLPIC & AVR Pro Programmer w/40 pin zif Combo #4.....$229.95

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Demo Software available for download

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HIGH QUALITY TEST EQUIPMENT

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DMM

DMM-898 ($179.00): true rms, AC/DC (V,A), Ω, bar graph, freq, capac., dBm, logic, diode

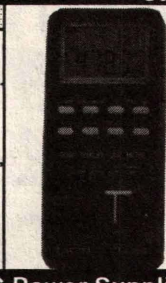
DMM-23T ($99.95): 4½ digit, true rms, high resol. (10µV, 10nA, 10mΩ), hFE, diode, contin.

DMM-20 ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle

DMM-122 ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity

DMM-123 ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity

DMM-10 ($19.95): 3½ digit, DC/AC V, Ω, hFE, diode, signal output(+3V,-0.5Vsq.,50%duty)



LCR/COUNTER

CAP-15 (*$49.95*): 3½ digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment.

LCR-24 (*$119.95*): 0.1µH-200H, 0.1pF-2000µF, 0.01Ω-20MΩ, diode test. *New Model.*

LCR-131D (*$219.95*): autorange, 0.1µH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/1kHz testing mode.

FC-1200 (*$129.95*): 1.25GHz Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz)

FLUKE

12B	$ 94.95
70-III	$ 99.00
73-III	$125.00
75-III	$155.00
77-III	$173.00
79-III	$195.00
87-III	$325.00
92B-III	$1,445
96B-II	$1,695
99B-III	$2,095
105B	$2,495
123-III	$1,130
863E	$555
867B	$740

SPECIALTY

• AC Current Probe	$34.95
• DC/AC Current Probe	$79.95
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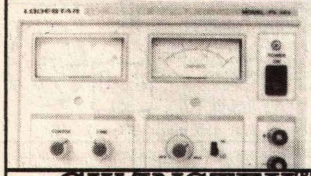
• AC Clamp w/temp	$89.95
• DC/AC Clamp	$109.95
• Thermometer	$69.95-$89.95
• IR Thermometer	$189.95
• Sound Level Meter	$169.95
• Tachometer	$169.95-$219.95
• EMF Tester	$69.95
• Pressure Meter	$299.95
• Watt Meter	$129.95
• High Voltgae Probe	$59.95
• pH Meter	$79.95
• Light Meter	$79.95-$89.95



Single Output DC Power Supplies

- Constant current, constant voltage mode
- Short Circuit and overload protected

Analog Meters Display	*Digital Volt, Analog Current*
PS-303 ($159.00) 30V/3A	PS-8200 ($179.95) 30V/3A
PS-305 ($219.95) 30V/5A	PS-8201 ($239.95) 30V/5A
PS-8112 ($399.95) 60V/5A	*Digital Volt & Current Display*
PS-1610 ($289.00) 16V/10A	PS-8300 ($199.95) 30V/3A
PS-8107 ($399.95) 30V/10A	PS-8301 ($259.95) 30V/5A

Triple Output

- Independence or Tracking operation
- Parallel to double current output (PS-8102 & PS-8103 only)

Triple Output (Analog displays)

PS-8102 ($399.95) 30V/3A/30V/3A

PS-8103 ($489.95) 30V/5A/30V/5A

Digital Displays

PS-8202 ($499.95) 30V/3A/30V/3A

PS-8203 ($549.95) 30V/5A/30V/5A

AUDIO/RF/FUNCT. GEN.

RF Generator • **SG-4160** ($124.95) 100kHz-150MHz sinewaves in 8 ranges

• **SG-4162AD**($229.95) with 6 digit counter

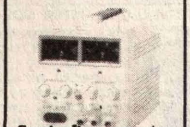
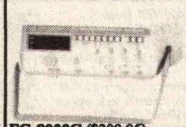
Audio Generator • AG-2601 ($124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave

• **AG-2603AD** ($229.95) with 6 digit counter

Function Generator • **FG-2100A ($154.95)** 0.2Hz-2MHz,5mV-20V_{pp}

• **FG-2103** ($329.95) *Sweep* 0.5Hz-5MHz

GW/INSTEK®

20 MHz Scope	Cursor Readout	Triple Output	Single Output	Programmable	FUNCTION GENERATOR	BENCHTOP DMM
						
• **OS-620 $324.95** • Most economical scope • Dual CH/X-Y operation • 1 mV/div sensitivity • Z-axis input,CH1 output • TV syn, ALT trigger • 2 probes (x1, x10)	• **OS-626G $599.95** • **Readout & Cursor meas** • Dual CH / Delay sweep • Built-in delay line • ALT trigger, Hold-Off • Z-axis input,CH1 output • 2 probes (x1, x10)	• 2 variable out 0-30V,0-3A • One fixed 5V,3A output • Auto track, serial, parallel • Const. volt, current mode • 4 analog or 2 digital display **PC-3030** ($499.95) **PC-3030D** ($549.95) digital	• Const voltage, current mo • Voltage regulation ≤0.01% • Current regulation ≤0.2% **PS-1830** ($198.95) 18V/3A **PS-1850** ($214.95) 18V/5A **PS-1830D**($214.95)18V/3A **PS-1850D**($244.95)18V/5A	• Auto serial/parall.(PPT ser) • Auto track (PPT series), IEEE-488.2 and SCPI compatible command set **PPS-1860G**($1,149.95)18V/6A **PPS-3635G**($1,149.95)36V/3.5A **PPT-1830G**($1,499.95)18V/3A **PPT-3615G**($1,499.95)36V1.5A	**FG-8020G** ($209.95) • 0.02Hz-2MHz w/counter • Sine/Squ/Tri/pulse/Ramp **FG-8020G** ($209.95) • 0.02Hz-2MHz w/counter **FG-8050** ($449.95) Sweep • 0.05Hz-5MHz w/counter • INT/EXT AM/FM mod	**DM-8034**($179.95) 3½ dgt • AC/DV(V,A),C,Ω,diode **DM-8040**($339.95) 3¾ dgt • ACV to 50kHz, true rms **DM-8055G**($889.95)5½dgt • 0.006% accuracy, GPIB • dBm,auto,REL, min/max

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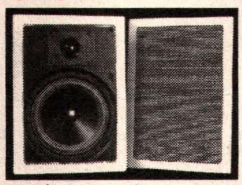
6-1/2" Two Way System



This is our most popular in-wall. You won't believe how good these really sound. Big enough to produce great home theatre sound and still fit everyone's budget. Put a pair in every room of your house. Great for front or rear speakers in your surround system. The 6-1/2" polypropylene woofer and 1" textile dome tweeter were specially designed with home theatre in mind. The crossover network utilizes a mylar capacitor for crisp clean highs. 3 piece design make installation in new or existing walls a snap.
Specifications: ◆6-1/2" polypropylene cone woofer with poly foam surround ◆1" textile dome tweeter/midrange ◆8 ohm impedance ◆3 component L/C crossover network ◆Frequency response: 50-20,000 Hz ◆Power handling capability: 60 watts RMS/85 watts max ◆Sensitivity: 89 dB 1W/1m ◆Overall dimensions: 8-1/2" W x 12" L x 3-1/2" D ◆Hole size: 7-1/4" x 10-3/4" ◆Fits into standard 2" x 4" wall ◆Net weight: 12 lbs. per pair.

#300-036 ..... $89.90(1-3 PRS) **$79.50**(4 PRS-UP)

6-1/2" Round Coaxial System

Designed for the home and office, these 6-1/2" round in-walls are ideal for ceiling installations, or for use as rear channel surround speakers. Adding music to the kitchen, den, bath, or patio has never been easier! System features a weather resistant 6-1/2" treated paper cone with poly foam surround, coaxially mounted 1/2" polymer dome tweeter, and built-in crossover with a mylar capacitor in the tweeter feed. Retrofit design allows installation in both new and existing construction in just minutes. System includes removable steel mesh grills, built-in mounting bracket, hardware, and installation instructions.
Specifications: ◆Impedance: 8 ohms ◆Frequency response: 60-20,000 Hz ◆Power handling capability: 30 watts RMS/45 watts max. ◆Sensitivity: 89 dB 1W/1m ◆Dimensions: 9" round x 2-7/8" deep. ◆Net weight: 5 lbs. per pair.

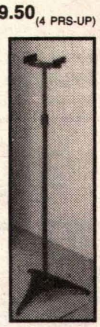
#300-408 ..... $69.95(1-3 PRS) **$62.75**(4PRS-UP)

Weller WLC100 Soldering Station

The Weller WLC100 solder station is ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost of an industrial unit. Power is adjustable from 5 to 40 watts. Includes 40 watt pencil iron. UL approved. Net weight: 1-3/4 lbs. Replacement sponge #372-119.

#372-120 ..... $39.95EACH

Satellite Speaker Stands



These quality speaker stands are perfect for mini or rear surround speakers. The heavy die cast base provides stability. Textured black satin finish blends in well with any decor. The height is adjustable from 26-1/2" to 47-1/2" and the speaker wire can be run inside the pole for a better appearance. The top base is adjustable from 4-1/8" to 7-1/2" to accommodate most mini speakers. Includes foam pads to prevent marring of speaker cabinet. Sold in pairs. Net weight: 12 lbs.

#240-762 ..... $39.80(1-3 PRS) **$35.50**(4 PRS-UP)

3 Amp Power Supply

This fully regulated power supply is perfect for powering CBs, car radios, and other 12 VDC devices that draw up to 3 amps. Heavy duty steel housing with front mounted switch and binding posts. Short circuit and overload protection!
Specifications: ◆Output Voltage: 13.8 VDC (fixed) ◆Output Current: 3A (cont), 5 amps (surge) ◆Ripple Voltage: Less than 3mV at rated output ◆Input Voltage: 120 VAC, 60Hz ◆Dimensions: 5-1/2" x 3-1/2" x 6-1/2" ◆Weight: 5 lbs.

#120-530 ..... $19.95(1-3) **$18.50**(4-UP)

"44" Solder

Kester "44" rosin core solder is designed for electronic and electrical work. It uses a fast acting, instant wetting, non-corrosive, and non-conductive flux for faster soldering and a strong, long lasting bond.

Part #	Alloy Lead/Tin	Spool	Dia.	Price (1-3)	Price (4-UP)
370-080	60/40	1 lb.	.031"	$8.50	$7.95
370-090	60/40	1 lb.	.050"	8.50	7.95
370-098	60/40	4 lb.	.031"	33.90	31.80
370-088	60/40	1/2 lb.	.020"	6.95	5.75
370-072	63/37	1 lb.	.020"	14.90	13.50
370-086	63/37	1/2 lb.	.031"	9.95	8.50
370-074	63/37	1 lb.	.031"	12.50	11.50
370-087	36/37	1/2 lb.	.031"	7.95	6.75

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#180-806 ..... $29.95(1-3) **$26.35**(4-UP)

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In addition to functions found in regular DMM's, this meter can also measure inductance in 5 ranges (4mH, 40mH, 400mH, 4H, 40H), capacitance in 5 ranges (4nF, 40nF, 400nF, 4uF, 400uF), frequency in 4 ranges (4KHz, 40KHz, 400KHz, 4MHz), TTL logic test, diode test and transistor hFE test. 5 AC/DC ranges up to 1000V (AC750V), 3 AC/DC current ranges up to 20A and 7 resistance ranges up to 4000 M ohms. Includes test leads, battery, spare fuse, and manual. Net weight: 1 lb.

#390-513 ..... $85.90EACH

Pro Wick

Pro Wick's advanced fine braid design provides wicking action that is second to none.

Part #	TS #	Size	Length	Price (1-9)	Price (10-UP)
341-415	1802-5	.06"	5'	$1.40	$1.25
341-416	1803-5	.08"	5'	1.45	1.30
341-417	1804-5	.10"	5'	1.60	1.45
341-424	1802-10	.06"	10'	2.75	2.50
341-425	1803-10	.08"	10'	2.80	2.55
341-426	1804-10	.10"	10'	2.95	2.70
341-440	1802-25F	.06"	25'	6.80	6.30
341-441	1803-25F	.08"	25'	6.85	6.35
341-442	1804-25F	.10"	25'	7.60	7.00
341-418	1802-100	.06"	100'	21.90	20.50
341-419	1803-100	.08"	100'	21.90	20.50
341-423	1804-100	.10"	100'	23.90	22.50

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General purpose 7 mil electrical tape. UL listed and CSA approved. 3/4" x 60' rolls.

#350-052 ..... 75¢(1-9) **59¢**(10-UP)

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#320-215 ..... $9.95EACH

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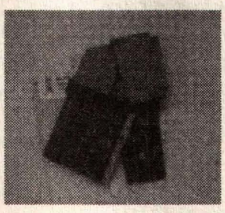

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COMPARE:	16C54	MV1200
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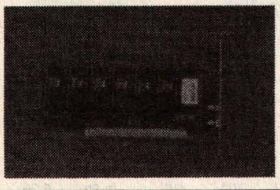
RS232 PROGRAM DOWNLOAD	NO	YES
SINGLE CHIP OPERATION	NO	YES
BUILT-IN BASIC	NO	YES
EEPROM DATA MEMORY	NONE	64
PROGRAM MEMORY	768 OTP	1K FLASH
MATH REGISTERS	1	32
MAX INSTRUCTIONS / SEC	5M	20M
MAX COUNTER BITS	16	18
INPUT / OUTPUT BITS	12	15
A TO D COMPARATOR	NO	YES
HARDWARE INTERRUPTS	NONE	3

PINOUT:

RESET	1	20	VCC
PD0	2	19	PB7
PD1	3	18	PB6
XOUT	4	17	PB5
XIN	5	16	PB4
PD2/INT	6	15	PB3
PD3	7	14	PB2
PD4/TMR	8	13	PB1/AD1
PD5	9	12	PB0/AD0
GND	10	11	PD6

- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -



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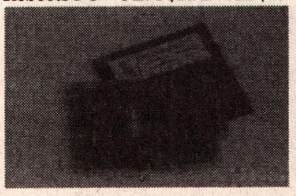

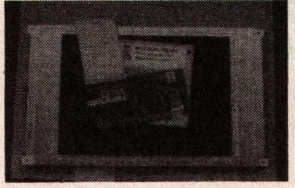

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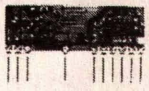

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- Carrier Detect output

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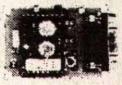
RS232 Transceiver



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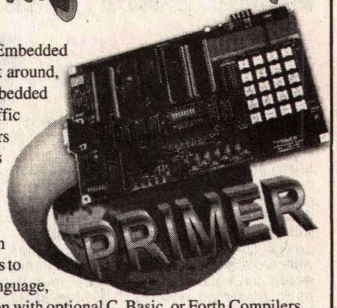

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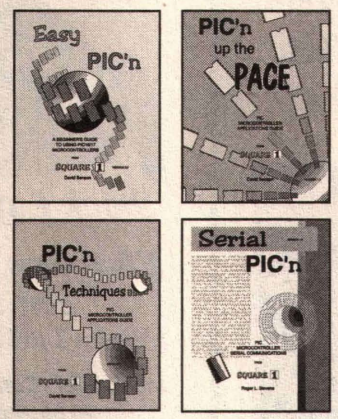

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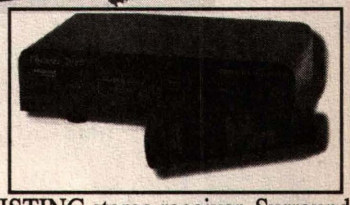

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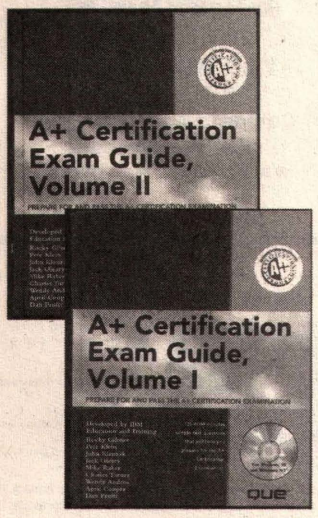

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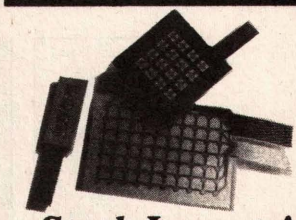

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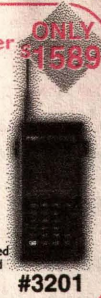

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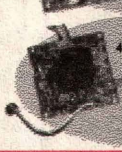

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Max Sweep Rate	2nS/Div to 0.2S/Div	0.1µS/Div to 0.2S/Div	0.1µS/Div to 0.2S/Div	0.2µS/Div to 0.5S/Div
Delay Sweep	YES	ALT-MAG	ALT-MAG	ALT-MAG
Vert. Mode Trig.	YES	YES	YES	YES
Cursor Readout	NO	NO	NO	NO
CRT Volts	12KV	10KV	10KV	2KV

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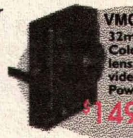

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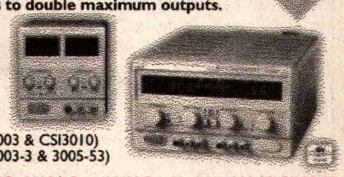

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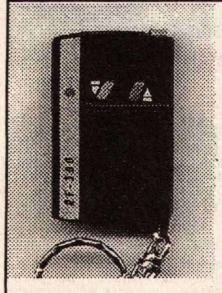

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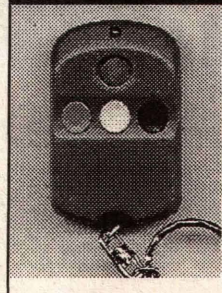

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- Frequency: 318 MHz
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- Push combination of buttons to achieve up to 15 channels

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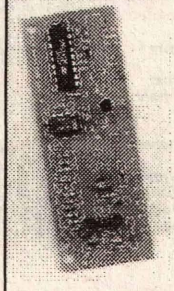

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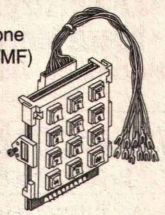

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CAT # KP-11

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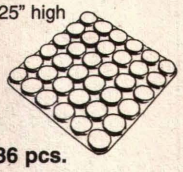

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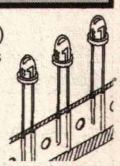

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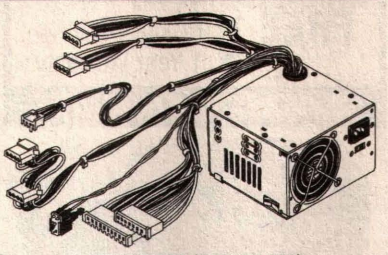

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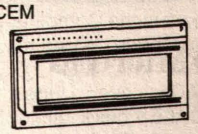

Optrex # DMC 20434-CEM (PWB 20434-CEM) 5 x 8 dot format. 3" x 1" viewing area. 3.88" x 2.38" module. Removed from new equipment. May have felt padding on metal bezel. 14 pin single row header is pre-attached. Spec/hook-up sheet included.

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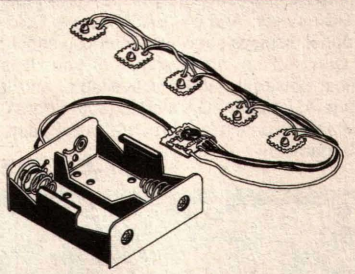

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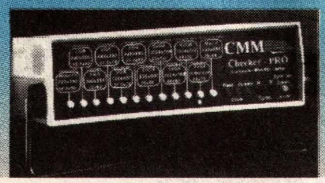

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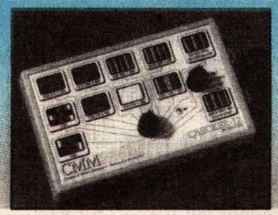

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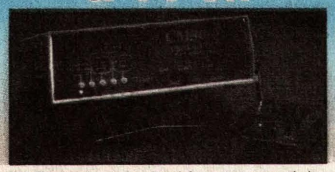

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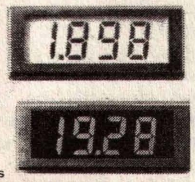

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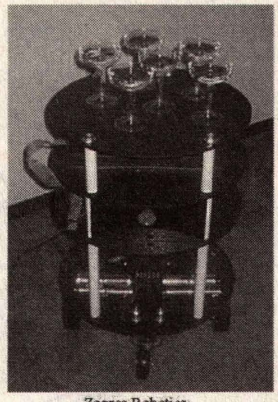

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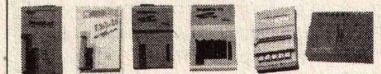

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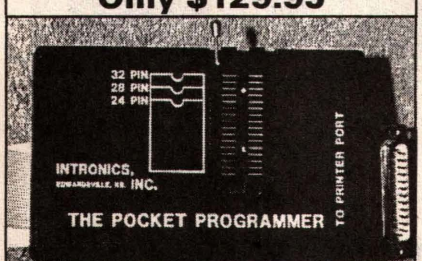

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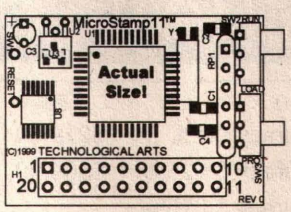

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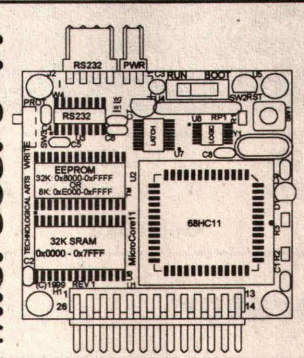

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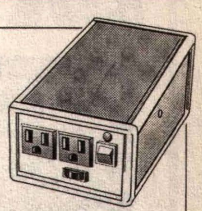

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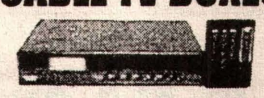

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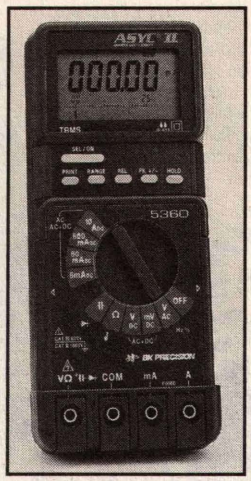

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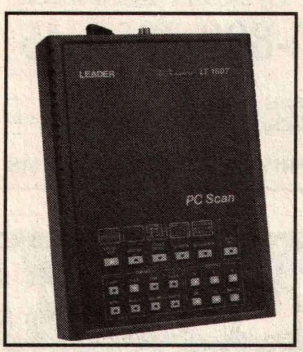

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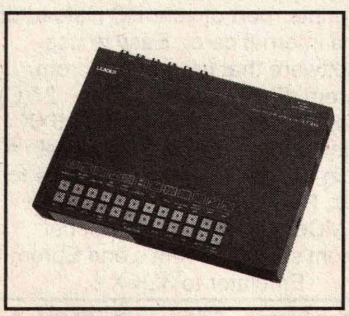

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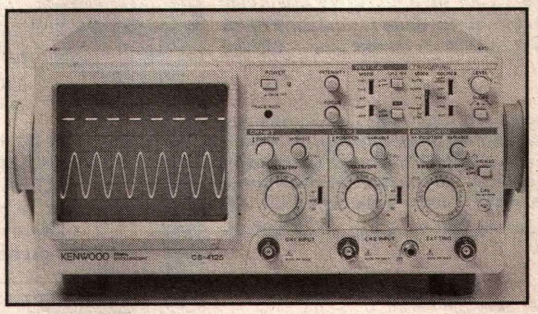

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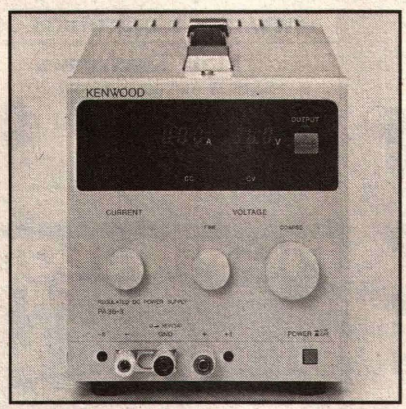

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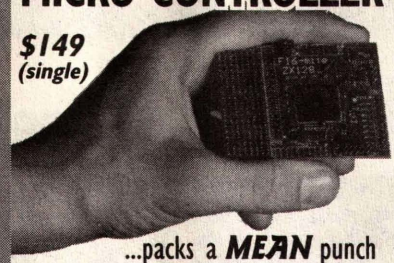

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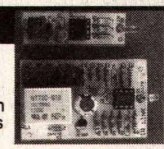

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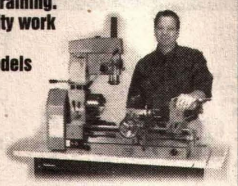

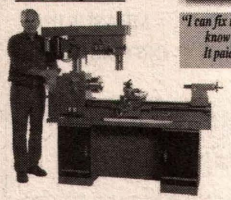

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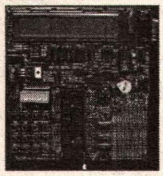

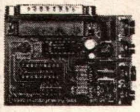

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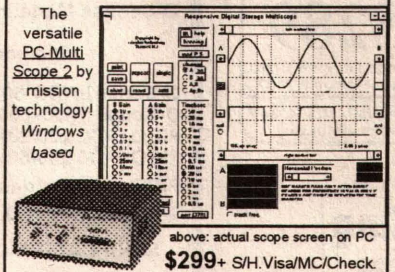

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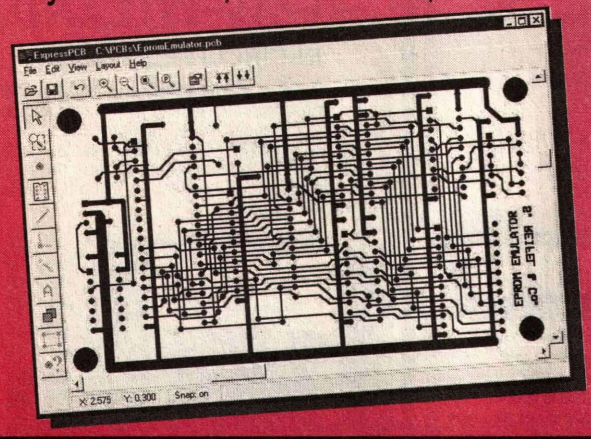

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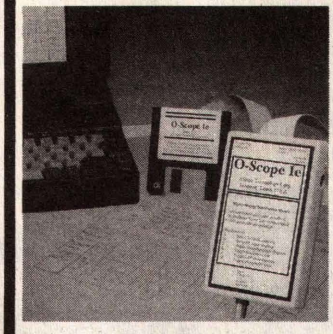

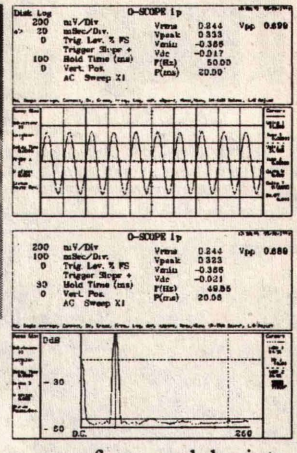

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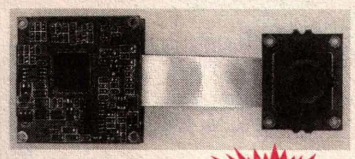

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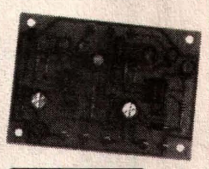

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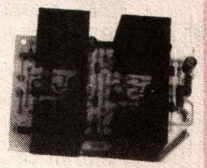

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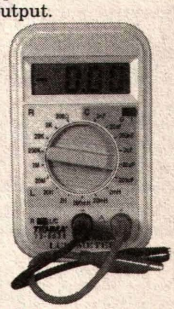

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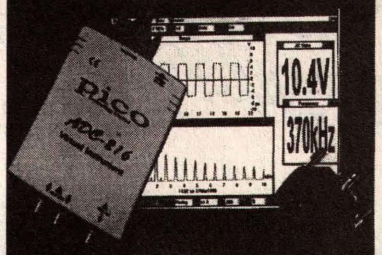

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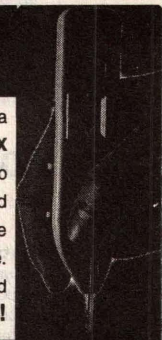

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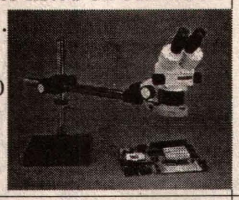

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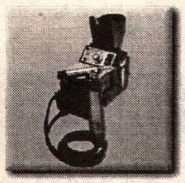

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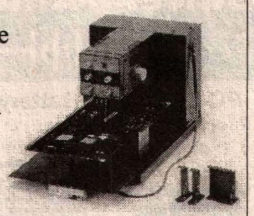

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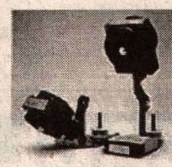

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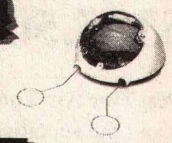

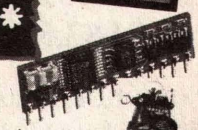

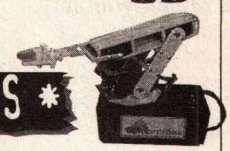

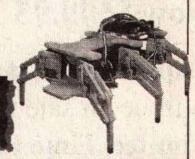

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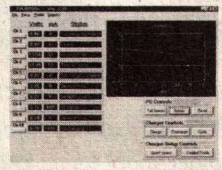

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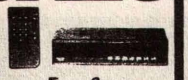

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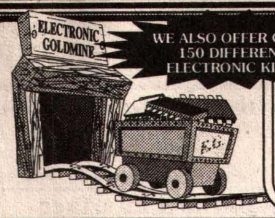

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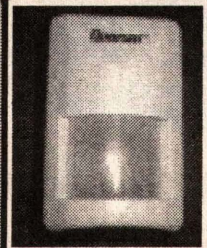

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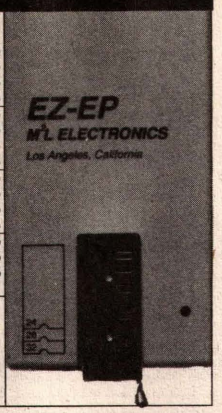

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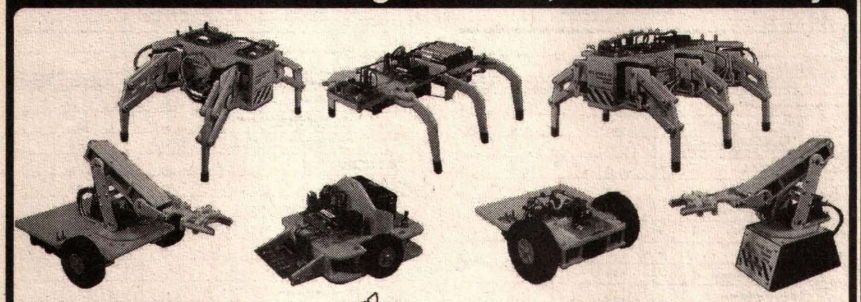

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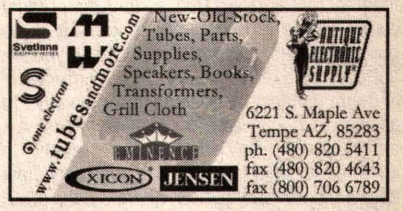

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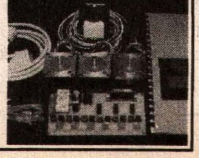

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4. Issue Frequency	5. Number of Issues Published Annually	6. Annual Subscription Price
MONTHLY	12	24.99

7. Complete Mailing Address of Known Office of Publication (Not printer) (Street, city, county, state, and ZIP+4): 500 BI-COUNTY BLVD., FARMINGDALE, NY 11735 — Contact Person: GINA GALLO — Telephone: 516-293-3000

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Percent Paid and/or Requested Circulation (15c / 15g x 100)		

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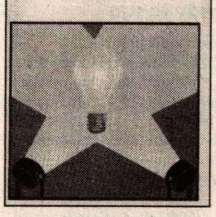

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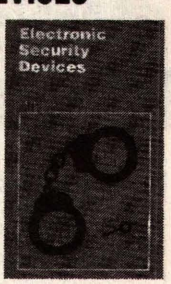

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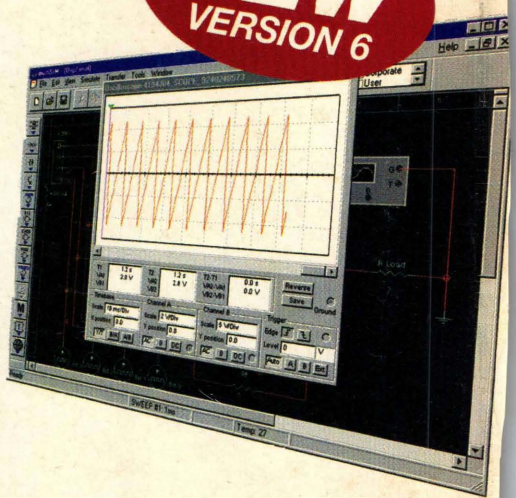

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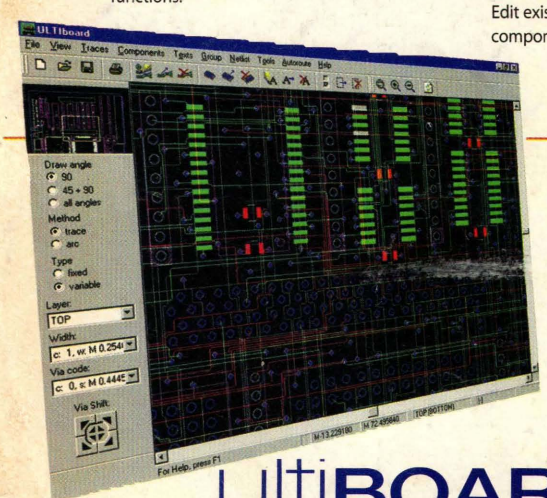

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